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NATIONAL PRODUCTIVE EFFICIENCY CONFERENCE

Wolverhampton, 8th March, 1947.

PROCEEDINGS

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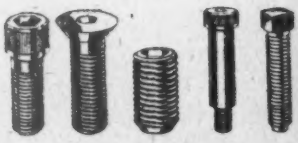

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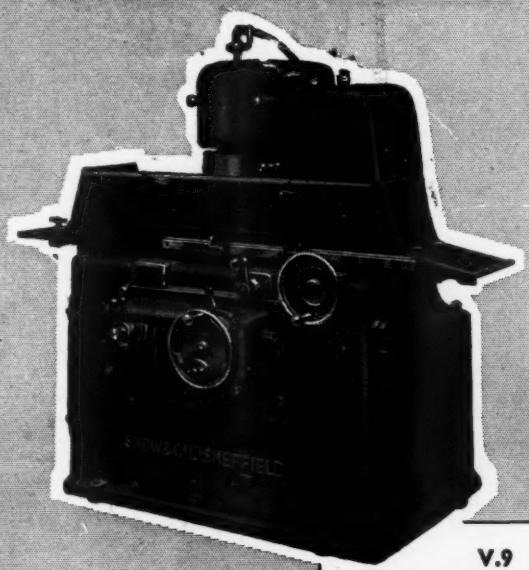

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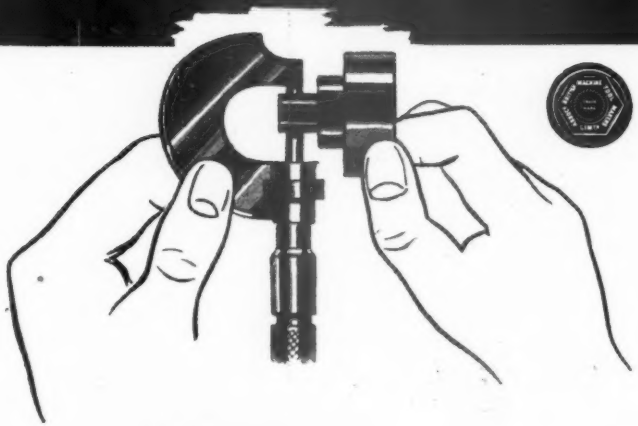

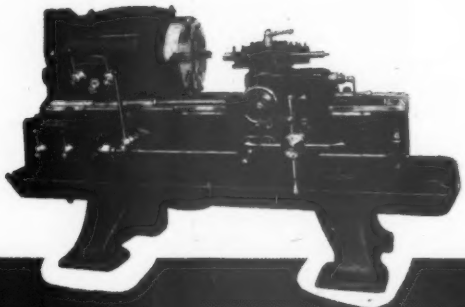

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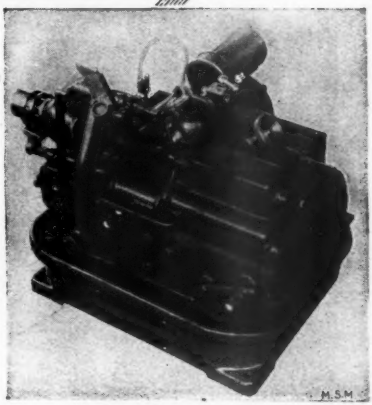

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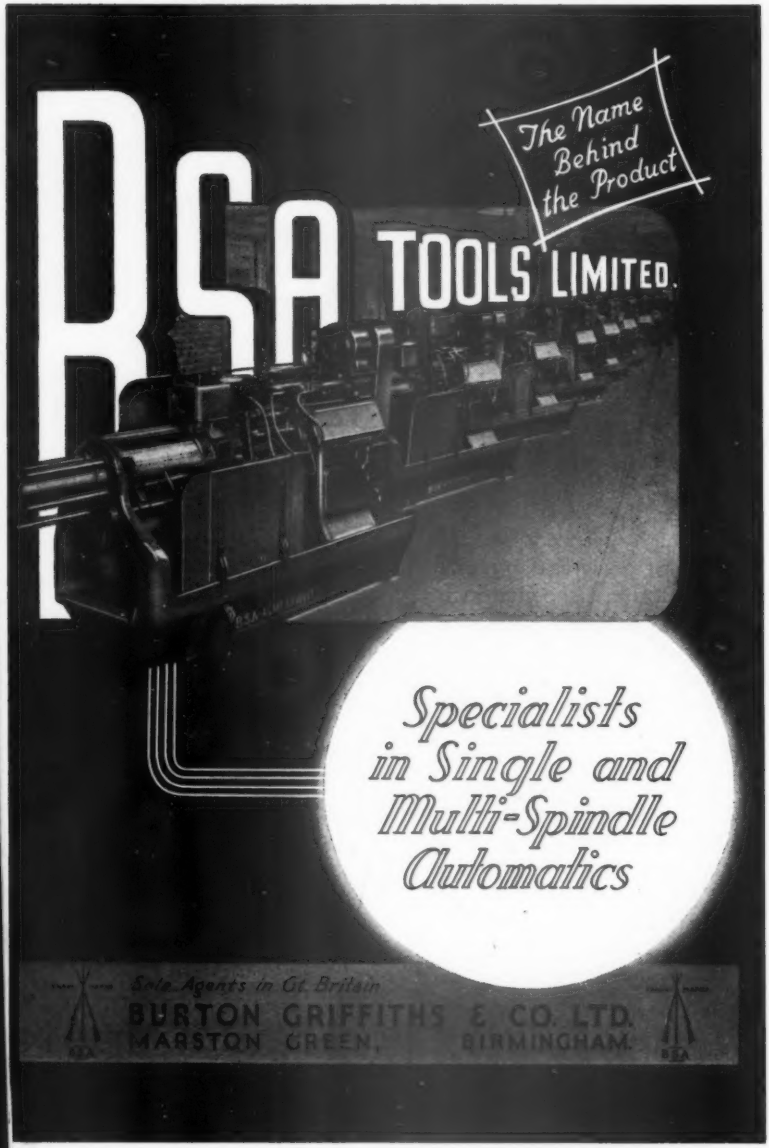
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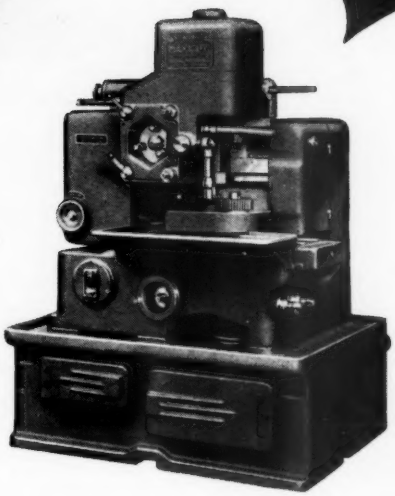

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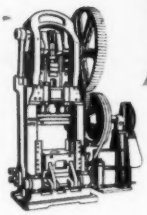

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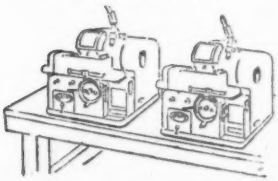

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organised by

THE WOLVERHAMPTON SECTION OF THE INSTITUTION

and held at

THE WOLVERHAMPTON & STAFFS. TECHNICAL COLLEGE.

MARCH 8th, 1947.

THE PROBLEM

The Fuel Crisis has forcibly demonstrated a weak spot in our National economic structure. Its incidence and effects were spectacular, and equal to anything we experienced during the war. Because of the vital and day-to-day necessity for fuel in all aspects of our national life, the crisis bore the urgent, short-term characteristic so familiar in war-time, and so effective in stirring the people of a democracy to immediate action.

The problem of increased production, urgent as it is, possesses none of the spectacular associations likely to move our population to a response such as is possible in times of war or crisis. The results of not attaining greater output are too hazy, too far off, and not appreciated sufficiently to stir any but the few who can appreciate the true implications. Furthermore, it is neither feasible nor desirable that the problem should be solved on the principle of a crisis since the tempo, once attained, must be of permanent, long-term duration.

There is a necessity, however, for the responsible elements of the nation to consider, as a crisis, the initiation of such principles as may lead to increased production since the question is of vital urgency and valuable time must elapse before measures can become effective.

Operating as mutual partners in industry are the three elements Man-Power, Management, and Equipment, and such improvements as may be possible must take place in one or more of these provinces. This Conference is an endeavour to initiate new ideas on these activities and it is hoped that something may emerge which will contribute to our future National well-being.

BRIEF HISTORY

During the First World War the unprecedented demand for the supply of armaments entailed a complete revision of methods of production. This brought together a small body of engineers whose aim it was to work out and discuss the many complex problems which then constantly arose, and to devise a means of exchanging ideas on production problems generally.

As a result of these meetings and discussions the Institution of Production Engineers was founded in 1921. Many of its original members were corporate members of the older engineering societies who were intent on influencing the training and development of young men destined to become Production Executives.

Since then, great progress has been made. The total membership of the Institution has risen to its present strength of approximately 7,000, including many individuals of outstanding academic attainment, together with a large percentage of highly-placed Works Executives. It became an incorporated body in 1931, and was granted armorial bearings in 1937.

The organisation operates through 37 self-governing Sections established throughout the British Commonwealth, and interest is maintained and developed by reading papers and holding discussions appertaining to production generally. Outstanding papers are published in the Institution's monthly Journal.

In recognition of its services, the Ministry of Education has granted a Higher National Certificate in Production Engineering and has subsequently issued revised "Notes for the Guidance of Colleges and Schools on the Arrangement of Courses in Production Engineering."

During the Second World War the Institution rendered valuable service not only to its members and affiliated firms, but also to His Majesty's Government at the request of various Ministries and Departments.

A Research Department was established in 1939, when the Governors of Loughborough College made available spacious laboratory premises for this purpose.

This development was the forerunner of the recently-formed Production Engineering Research Association of Great Britain, sponsored not only by the Institution, but also by the Gauge and

Tool Makers' Association, the Machine Tool Trades Association, and the National Federation of Engineers' Tool Manufacturers, with the financial support of His Majesty's Government through the Department of Scientific and Industrial Research.

In addition to the foregoing a number of prominent members of the Institution were among the delegates at the Ottawa Conference held in the Autumn of 1945, on the Unification of Screw Threads. This was followed up by a series of discussions held throughout the Sections of the Institution, with the result that the consolidated findings were shown fully to support the views of that Conference.

During the year 1946, the Institution was honoured by an invitation to attend the first post-war Convention of its sister body in the United States, the American Society of Tool Engineers. Mr. E. W. Hancock, M.B.E. who was delegated to represent the Institution, became the guest of the A.S.T.E. from the moment he left Great Britain by air for the United States. The Institution is most appreciative of this generous gesture on the part of their American friends.

The Institution has made a major contribution in the field of technical education, and many of its recommendations were contained in the Percy Report of the Ministry of Education, published in 1945. It has been decided to appoint a full time Education Officer with the object of improving collaboration with the Government, Technical Colleges and Industry.

It is gratifying to record that the Institution has developed very rapidly in both stature and membership during the last three years, the membership having more than doubled itself. In the direction of its affairs, the most progressive measures are being introduced which must inevitably lead to the Institution playing a vital part in the industrial recovery of the country.

The Wolverhampton Section.

This Section, one of the youngest in the Institution, was formed in November, 1943, with Mr. E. W. Hancock, M.B.E., M.I.P.E., as its first President. Its development has been rapid and there are now about 400 attached members. In June, 1944, a Graduate Section was formed and in January, 1945, a sub-Section was set up at Shrewsbury. Early in 1945 a useful contribution was made to the war effort by collaboration with the Wolverhampton and District Production Committee in operating a successful series of lectures on Statistical Quality Control.

For the purpose of covering the area concerned, meetings are held in succession at Wolverhampton, Walsall, Wednesbury and Dudley. The Section owes much to the co-operation accorded by the Technical Colleges where most of the meetings are held, not only for providing facilities, but also in fostering the technical education of Graduates.

Section Officers for the current year are as follows :

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OPENING OF THE CONFERENCE

The Conference was officially opened at 10 a.m. on Saturday, March 8th, 1947, by His Worship the Mayor of Wolverhampton, Alderman C. B. V. Taylor, who said he considered his duty an important one. The Institution of Production Engineers at the present time was one of the most important organisations in existence.

Production and export were vital factors in the national life, and with the help of such bodies as the Institution, it was hoped that we should all reach the promised land of industrial recovery.

After welcoming the representatives to Wolverhampton, and wishing the Conference every success, Alderman Taylor then called upon Dr. W. A. J. Chapman, Principal of the County Technical College, Stafford, and President of Wolverhampton Section.

Dr. Chapman said that he was sorry to announce that Dr. H. Schofield, C.B.E., Chairman of Council, was unfortunately suffering from influenza, and would not be able to attend. Sir Norman Kipping was unable to get away from London, but the Right Hon. Lord Sempill, A.F.C., had generously offered to deputise for him in introducing Sir Godfrey H. Ince.

Dr. Chapman also had to apologise for the absence of Alderman Clark, Chairman of the Education Committee, who was prevented by illness from attending. He was sure the Conference would approve his sending their sympathies to those who were ill.

He had pleasure in now calling upon the Right Hon. Lord Sempill.

Lord Sempill said he was proud indeed to be with them, having just arrived from a series of meetings in Paris, but he was afraid he was a poor substitute for Sir Norman Kipping.

He was glad to have the opportunity, on behalf of all the members present, of thanking the Mayor of Wolverhampton for the warm welcome he had given to those who did not normally work in Wolverhampton.

He did not intend to enter into a dissertation on snow removal ; he left that to Mr. Hancock, who would address them later. What he did want to say was this : the Institution had had many conferences, but without question they had never before met at a conference as important as the present one which had just been opened by the Mayor of Wolverhampton, because the circumstances were such that they demanded in the fullest possible measure the full effect of the Institution of Production Engineers and their work. Also, they had never before met in the presence of the Senior Official of the Ministry of Labour and National Service, the Permanent Under-Secretary

of that great institution, Sir Godfrey H. Ince. They looked forward to his address on Britain's Manpower Budget with keen anticipation.

The situation that faced them was one which gave them an immense opportunity and a definite responsibility because, as they knew so well from all they had heard from the different Ministries as to what was expected from those in the country concerned with production, unless we could produce far more, far better, more efficiently and more effectively than in the past, we should very rapidly find ourselves, as a nation, on very short commons. Therefore, there were assembled there the pioneers and leaders in thought and activity in the Institution, several of whom were to give papers, and all of whom would contribute to the discussions on those papers. There was no doubt that they would have a very important and educative day.

The issue divided itself into two phases, one of which was the scientific and technological phase, which they in the Institution, as production engineers, represented and directed. But that phase, important as it was, could come to nothing unless there was, throughout the whole country, the right spirit motivating those concerned with it. Unless they had the right spirit, derived from a proper spiritual understanding of their responsibilities as citizens, all those sciences and technologies and art that the Institution applied would be as nothing at all. They had got to have that will activating each one of them behind the whole machine of production, otherwise the whole would come to nothing.

It was often true that where operatives well equipped were not producing as much as others not so well equipped, it was because in many cases there was no team spirit. It was not only a question of the science and art of the production engineer which was important, but it was vitally important that each one should have the right spirit.

Today this country faced a situation exactly parallel to that which was faced at Dunkirk, but with the right direction from above, and the spirit to do a particular job in the moment of emergency at the right pace, it was certain that this situation would be successfully negotiated.

Lord Sempill warmly welcomed Sir Godfrey Ince, who had a record of service in the 1914-18 war of which anyone would be proud. Since 1919, he had devoted all his energies to the Ministry of Labour and National Service. Ministers came and Ministers went, but Sir Godfrey Ince was always there, and what good had come from the Ministry of Labour was the product of his active brain.

"BRITAIN'S MANPOWER BUDGET"

By Sir GODFREY H. INCE, K.C.B., K.B.E., C.B.

It gives me very great pleasure to be in Wolverhampton this morning, and I am glad to hear that it is the most important city in this country. What I do know about it is that it has the best football team in the country.

This is the first time I have had the honour of addressing an audience composed of production engineers. During the war I had the opportunity of being present at a great meeting which Mr. Bevin, who was then Minister of Labour, addressed in London. I dare say many of you were present on that occasion. I also had the pleasure of being present when he addressed a similar audience in South Wales during the war.

The subject on which I am to talk this morning is Britain's Manpower Budget. I am in just a little difficulty, because one cannot foresee at the moment what the effect of the present crisis may be on the distribution of man-power in the coming year, and I can only proceed on the basis of the Economic Survey, that is, with the position as we saw it two or three weeks ago. It is on that basis that I want to talk this morning.

You know that during the war we mobilised the man and woman power of the nation to the hilt. We are suffering today from the fact that we threw everything into the war effort, and when you do that, it takes a considerable time to get your economy back on to its peace basis, and on to a stable basis.

We reached the peak of our man-power in September 1943, but we did not reach the peak of everything on that date. For Civil Defence, we reached the peak very much earlier, in December 1941 ; for Munition Production and Equipment and Supplies to the Forces we reached the peak in September 1943. But as far as the strength of the Forces was concerned, that peak was not reached until about a year later, the time of the invasion of Europe, when we and the Americans landed on the beaches of Normandy. That was in accordance with the overall plan for man-power that we should reach the maximum striking force at the time when maximum impact against the enemy was required. Since September 1943, our man-power has been running down, and it is still running down. But, in spite of the fact that from September 1943, our man-power was running down, we increased the intensity of our mobilisation for operational purposes right up to " D " day. Thereafter, having reached the peak of the strength of our forces, and in spite of everything, we succeeded in maintaining the strength of our forces at that high peak right up to the time of the defeat of Germany.

Since then there has been a tremendous change-over. Our man-power has run down quite rapidly since the end of the war, when very large numbers of people who had come in for the war effort, hundreds of thousands of married women (women who had been doing two jobs in the war) went home again ; also very large numbers of the older people who had remained on to do a war job went out of industry. We have today reached the stage where all those additional people who came in to help the war effort have, in fact, gone back home.

But our man-power is still running down, and it is running down for the reason that the birth-rate in this country continued to fall in the 1930's. To show the effect I quote some figures that I have quoted before, as they illustrate the position so vividly. In 1939, 417,000 young men reached the age of 18 ; last year, 335,000 young men reached the age of 18 ; in 1950 only 295,000 young men will reach the age of 18. That is a serious matter from the man-power point of view, and with the fall in the birth-rate and the raising of the school-leaving age, industry in ten years will have just half the number of juveniles that it has today. The youth of the country is our most priceless asset, and it is getting scarcer. It is therefore up to industry to see that the youth of this country that goes into industry is properly trained, and that the very best use is made of every boy and every girl.

Since the end of the war there has been a tremendous change-over in man-power. Over four and a quarter million men and women have been released from the Forces. The munitions industries and the industries producing equipment for the Forces have gone down from 3,900,000 to 450,000—a reduction of just about three and a half million. That change-over has been effected with very great smoothness, due I think in the main to two reasons. First, because of the very careful plans that we made before the end of the war for the change-over, plans that were worked out in my department under Mr. Ernest Bevin, and secondly, because of the lack of industrial unrest. We have had, I know, a number of stoppages of work, but practically all the stoppages have been unofficial. Compared with the position at the end of the last war they have been extremely small, and that has been of the greatest advantage to this country in the change-over from a war to a peace economy.

Now if you take the basic industries of the country, the public services, the building and civil engineering industry, the distributive trades and the miscellaneous trades and services, you will find that the man-power engaged in these industries and services, taken as a whole, has remained practically stable. We had something like 11,200,000 engaged in all these industries in 1939. There have been a number of fluctuations during the war and today the total is about 11,300,000, only about 100,000 above pre-war. So you will see the

man-power has remained about stable, although there have been fluctuations in individual industries.

The differences between pre-war and today are in the manufacturing industries of the country, which are engaged on three main tasks. One, the production of equipment and supplies for the Forces; as I have said there are 450,000 engaged on that, which is very much lower than before the war when we had a million and a quarter engaged in making munitions and equipment. This is a reduction therefore, compared with before the war, of about 800,000, and that is split up between the metal and chemical industries and all the other manufacturing industries. The reduction is 700,000 as far as metal and chemical industries are concerned, and 100,000 as far as the others are concerned.

The second task is production of manufactures for the export market, and on that before the war we had 900,000 people engaged ; today we have 1,466,000 engaged. In other words about 48 per cent. more are engaged on the production of manufactured goods for export than we had before the war. As far as the manufacture of goods for the home market is concerned, before the war we had just over four and a half million engaged on it. At the end of 1946 we had just over five million, an increase of something like half a million. If you look at the two main groups however, engaged both in exports and the manufacture for the home market, you will see that there is a very great distortion of our economy. On exports, for example, while in the other manufacturing industries we have about the same numbers engaged as before the war, in the metal and chemical industries we have half a million more people engaged. In the home market, we have 900,000 more men and women in the metal and chemical industries engaged on the production of goods for the home market than before the war, whereas in the other manufacturing industries of the country, textiles, cotton, wool, hosiery, boots and shoes, leather goods and so on, we have 450,000 less.

Summing all this up, in our manufacturing industries as a whole the position is that we have something like 700,000 more men and women engaged in metal and chemical industries, and over 500,000 less engaged in the other manufacturing industries of the country. Therefore, while looking at the picture as a whole and seeing that we have 48 per cent. more people on exports, ten per cent more in manufacture for the home market looks very satisfactory. But when you come to examine it you find it is not nearly so satisfactory as it seems, and for two reasons. One : because we still want more man-power in the manufacturing industries, and, two : because it is not rightly distributed.

As to wanting more people engaged in these industries, first let me take exports. I take them quite deliberately because exports are of the most fundamental importance to our economy. At present, as

you know, we are importing a little over 70 per cent. of what we imported before the war, and are not able today to produce sufficient exports to pay for these reduced imports. Until we can expand our exports to pay for our imports, there is little hope of increasing the latter still further. In other words, we have still to live a life of austerity, and until we can produce sufficient exports to balance our foreign trade we are likely to be running into the most serious economic danger. The Government has announced that in order to balance our foreign trade, we have to produce in volume, exports to the extent of 75 per cent. above pre-war, and in order to do that we have to increase the man-power in our manufacturing industries engaged on exports up to about two million. We are nearly one million and a half today. The target set for the end of this year is one million seven hundred thousand, that is, to achieve an increase in volume of our exports of about 40 per cent. over pre-war, and in order to produce 75 per cent. we have to have another half-million men and women, making a total of about two million.

Why is it necessary to have twice the man-power in our manufacturing industries to produce a 75 per cent increase? It all goes back to the fundamental question of coal. You know that before the war one of our greatest exports was coal and we had something like 160,000 men in the mining industry engaged on the production of coal for export. Today we do not export coal—we cannot. It does not look as if we are going to have much hope of exporting coal in the near future. That means therefore that the manufacturing industries of the country have to produce the goods to take the place of the coal exports. Therefore the manufacturing industries have to produce double the amount of exports in volume that they produced pre-war to make up for the lack of coal exports, and there is going to be this greatly added burden on the manufacturing industries of this country to produce the exports which we must have if we are to live.

In the home market, we are today about ten per cent. above our pre-war man-power. We want still more. Our industries, and this applies to the engineering industries, have two great tasks. They have to provide the majority of the goods for export, but they also have something else to do. They have to re-equip the industry of this country; if industry is not re-equipped, we shall not be able to hold our own in the markets of the world when we come to a buyer's market.

Perhaps I might just give you the figures for the engineering industries. These include general, electrical, marine and constructional engineering, production of motor cars, bicycles, and aircraft. You may think it is irrelevant to include aircraft, but our figures are not sufficiently broken down to exclude them. Before the war there were something like 1,440,000 men and women in these industries. Today, there are about 1,815,000, an increase of 375,000. There is a

reduction in munitions and equipment for the forces of about 220,000 ; an increase in those engaged on exports of about 260,000 and an increase in the numbers of those making goods for the home market of about 340,000. It is on these people, engaged in these engineering industries, that the economic future of this country mainly depends.

I have shown you that our economy is distorted—that we have a much larger number of people engaged in the engineering and other metal industries of the country, and fewer people in the other manufacturing industries than in pre-war days. I do not wish to suggest that the engineering industries have got too much man-power but what I do say is that in our shortage of man-power these industries cannot have more, and that the increases which they have at the present time are at the expense of our other manufacturing industries. Our great problem is to try and increase the labour force in some of these latter industries. In our cotton industry, which is so important, there is no hope whatever of increasing the clothes ration unless we can get more people in cotton spinning. One of our major tasks of the future is to correct this distortion. I would emphasise that, in the present circumstances, we cannot afford to let the engineering industries have any more man-power.

I have said that you have two great tasks—exports, and re-equipping this country. Exports are undoubtedly the most vital thing for our future economic success, but in the long run the re-equipment of our industries is equally important. If our man-power is going to continue to be short, there is only one way in which we can make up for it, and that is by increased productivity. There is no other method.

It is possible that as a result of our present crisis and the shortage of coal we may not be able to employ all the people we have for some time, and there may be a certain measure of unemployment. But even if that is the position, that does not mean that we have not to produce more. It means that we have to produce more than ever with all the people we have in industry.

Increased production and productivity is a question of the three "M's "—Men, Management and Machines. I do not suggest that it is just a question of telling the workpeople of this country that they have to work a bit harder. This question of increased production is a joint matter. It is a matter which affects management as well as men and there is a great responsibility on both sides of industry today—a great responsibility with the men and women employed in the industries of this country, and a great responsibility resting on the management. That responsibility has undoubtedly been increased as a result of the position at the present time arising from the crisis of the last three weeks, and it is therefore up to both management and men in industry to foster that spirit which Lord

Sempill referred to in his opening remarks, because without the right spirit in industry we have no hope whatever of getting increased production, which is so vital.

Finally, on you, the production engineers of this country, rests, I believe, a greater responsibility than on any other body of management. I am extremely glad, therefore, that at this critical period in the history of this country you should be meeting here today in one of the great industrial centres of the country to discuss many of the problems with which you are going to be faced in the future.

The Mayor said he was certain that they would agree that Sir Godfrey had told them something of great importance. On their behalf he thanked Sir Godfrey sincerely for his address, and only wished it could be shouted from the hill tops, so that everyone in the country might know that from workmen to management, everyone had to pull his weight. As soon as each individual acted on that principle, this country would be put on its feet again.

DR. CHAPMAN, on behalf of those present and of the Wolverhampton Section, reinforced the thanks of Lord Sempill to Sir Godfrey for coming down, and for the clear way in which he had laid bare the economic position.

He thought that Sir Godfrey would prefer that they should not spend too much time in thanking him, but should get on with the job for which they had come there. He therefore gave notice that the Conference would split up into the "working parties", if they wished to call them such.

If those present were not sure which group to join, he appealed to them to join either the Man-power or the Equipment groups. For some reason the popular feeling seemed to be that management was the way out of our difficulties, but after hearing Sir Godfrey, he was inclined to think that Man-power was the way out.

The Conference then split up into the sections on Man-power, Management, and Plant and Equipment.

MAN-POWER GROUP.

"TRAINING FOR EFFICIENT PRODUCTION"

By J. W. BERRY, M.I.Mech.E., M.I.P.E.

Chairman:

The Rt. Hon. LORD SEMPILL, A.F.C., F.R.Ae.S., M.I.P.E.

(Mr. Berry is Works Director of the Birmingham Aluminium Casting (1903) Co. Ltd., and a Member of Council of the Institution of Production Engineers. He is Chairman of the Joint Examination Board. Past President of the Birmingham Section, and Past Chairman of the I.P.E. Education Committee.)

Gentlemen, I much appreciate the honour of being allowed to express a few thoughts, and, I hope, promote some discussion on this important factor of Training for Production. I am doubly pleased that the venue of this discussion has been located at the Wolverhampton and Staffordshire Technical College, which was one of the first to institute courses in Production Engineering, and I would like to pay tribute to Dr. Fisher and make an acknowledgement of the help and advice he has given to the Institution of Production Engineers during their efforts towards rationalised technical training.

The negative attitude of the Board of Education over the years was merely a phase of the attitude of mind of successive governments towards industry as a whole. With conditions as they are today, the loss of all foreign investments plus our heavy indebtedness in many countries abroad, the withdrawal of British influence from many countries, this attitude can no longer be tolerated. It is vital, therefore, that the steady but none-the-less serious flow of youth into black-coated occupations must be resisted, and the flow of youth, fully trained practically and technically, be directed back into industry.

The present trend of youth into black-coated occupations is due to two main causes: firstly, the subjugation of pride of craft and a form of snobbery whereby the youth, encouraged by parental influence, is taught to despise the occupations in industry, and there is an increased disinclination on the part of the youth to soil his hands: secondly, this snobbery has been fostered both in Elementary and in Secondary School education—emphasis has been put on the safe, clean job to the detriment of the spirit of adventure upon which the industrial development of this country, and its success, has depended.

The attitude of the then Board of Education towards vocational training in Technical Schools has still further discouraged youth, for

vocational training in Technical Schools has, until quite recently, been unrecognised except as part of a minor course.

Industry itself cannot be held blameless in this responsibility, for with a few exceptions, it has been strangely inarticulate and has been prepared to accept what was given to it, not taking sufficient interest in technical training, nor giving sufficient encouragement to employees to continue education during their early years in industry.

So much for the past, now as to the future :—

Before one can embark upon a satisfactory scheme of training (and by that I mean a National scheme), both sides, Industry and the Educational Authorities, must become aware of and accept the change in industrial methods. The growth of mass production, and by " mass production " I mean quality as well as quantity, has moved the centre of gravity of the industrial machine from design to production, and I submit that the centre of gravity of education must be transferred in a like manner if the balance of training is to be effective. I would go further, and say that this correlation of technical and practical training is just as important in the production of a " small batch " or even of " one off."

The training of the efficient production engineer should be visualised as a whole, and there should be throughout this training a partnership between industry and those responsible for education, and this training should embrace both the technical and practical aspects. The practical side will, of necessity, be arranged around the occupation of the trainee. It is equally important that the technical side would be framed around the ultimate occupation of the trainee and not a disconnected, highly academic, pot-hunting scheme of training.

Education Authorities must be forced to acknowledge that subjects allied to occupation are of equal importance with the higher academic subjects, which have hitherto been held to be essential, before vocational training has been given.

We are about to embark upon a revised system of education—the school-leaving age is to be raised, youth will be coming into industry one or two years later than has been the case heretofore. We cannot, therefore, afford to continue with the " hit or miss " methods of the past.

It is impossible, in a paper of this length, to go into detailed examination of the subject and one must, therefore, be satisfied with fundamentals. I will divide these into two main headings :

1. Factory Training.
2. Technical Education : (*a*) The Student.
   (*b*) The Teacher.
   (*c*) The Equipment.

Factory Training.

Factory Training should be a comprehensive one and safeguards must be made (if necessary imposed by legislation) against the exploitation of youth by using them for blind-alley jobs or keeping them engaged on one machine for too long, in order to obtain production.

Apprenticeship schemes should be the rule rather than the exception, and a definite contact between representatives of Industry, Trade Unions and the Local Education Authorities should be established to make sure that the trainee is attending classes which are suitable for his outlook and his ambitions.

In the larger Works, the appointment of an Apprentice Supervisor is generally accepted, but in the smaller Works, where this could not be a full-time job, a man of high status should be made responsible for the apprentices and he should have authority to place them in a department or on a machine which he considers suitable, and his authority should not be over-ridden by the foreman of the Department.

To visualize the difficulty of a nation-wide scheme for factory training, one must first of all look at the structure of Industry. In the Engineering Industry, 27.9 per cent. of the undertakings employ less than 50 manual workers, 20 per cent. between 100 and 250, and 11.9 per cent. employ 1,000 and over. In the Foundries, the position is even more difficult, for out of 1,759 foundries only 133 employ more than 200 people, and 696 foundries employ less than 25. Whilst this structure was our salvation in the war, due to the flexibility and the ingenuity of the smaller firms, it has always been our weakness when it comes to the organised training of apprentices. It will be remembered by many of my listeners that a similar frantic interest was displayed in apprenticeship schemes following the difficulties of the 1914-1918 War, and I believe that the fading of interest at that time was due in no small measure to the failure of apprenticeship schemes in small Works, and unless energetic steps are taken in the future to avoid this, history will repeat itself.

In the large firms, apprenticeship schemes have been evolved for many years and are doing excellent work. A greater number of the medium-sized firms are becoming apprenticeship-conscious and new schemes have come in during recent years, but still there is the difficulty with the small firms. Let us, however, look just briefly at some of the methods adopted by the larger firms for the intake and treatment of apprentices.

I have written to four of the larger industrial organisations and have asked them each to answer four main questions. The first question was, "Do you have an apprentice school for Technical training?" In reply, only one firm stated that they had a school

within its organisation, but all the other three emphasised the efficiency of the local Technical College. By contrast, in reply to question 2, " Do you have special workshops for the practical training of apprentices ? " three of the four firms replied that they did have special workshops, although this was chiefly used for the first six months or so.

My third question, "Do you distinguish between Craft and Engineering Apprentices on entry ? " was answered with a unanimous affirmative, but all were equally unanimous in reply to question No. 4, " Is it possible for a craft apprentice to proceed on to the full Engineering apprenticeship ? " that this was a possibility. One firm also stated that it was also possible for an Engineering Apprentice " not making the grade " to revert to a Trade Apprentice.

My own, personal reaction to this aspect of training is as follows:

Whilst watertight compartments are never entirely successful, and with technical education of the type we have under review, I would be the last one to suggest that there should be a hard-and-fast division between the Technical School or County College and the Works, yet at the same time I do feel that each has its own sphere of influence and its own responsibility and duty, and I would deprecate a state of affairs where, on the one hand the technical college should attempt to teach a trade, or on the other that a Works should attempt the full scale of technical training; for one thing the interchange of views, personalities and experiences which is only possible by students from various industries coming together on the floor of the school or college, is of first-rate importance. No less important is the absorption of factory atmosphere and the rubbing shoulders with the skilled craftsman—and to this end I would limit the setting aside of apprentice workshops to the earlier stages of the training.

There is, I agree, a lot to be said for the correct reception of the apprentices, for the early impressions and instructions given to him in the care of tools, pride of craft, pride of personal appearance, and of shop appearance, but this is only one phase of his industrial life—the greater and more important part of his apprentice life is what happens in actual practice.

With the many large schemes in operation, there is little to fear of the apprentice going wrong. We may not agree with all the schemes in detail, and I, for one, am very keen on the true factory atmosphere being absorbed by the apprentice. To this end, so far as Works training is concerned, I would prefer that the apprentice, after a maximum of six months' preliminary training, should gain his experience in actual production. There is, however, one difficulty in this method, and that is the question of payment by results. Whilst I have said that I believe in the factory atmosphere and whilst it is true that part of the factory atmosphere is of necessity, one of working against time, or to time, I would make it impossible for apprentices

or youths under the age of 18 to take part in a system of payment by results. Too many young men have gone wrong due to the lure of money in their early youth, and have preferred to continue on repetition jobs because of the attraction of the pay packets at the end of the week. He should, at least, be carried forward to the relatively mature age of 18 before this temptation is put in front of him. Beyond that age, I would agree that he must learn not only his craft but the importance of the time factor in Industry and of his productive efforts. Therefore, some inclusion of payments by results would not be out of the way at this stage.

In the smaller firms, this temptation is much greater because of the absence of the guiding influence of apprentice supervisors whose minds are free from the responsibility of production and economics. In smaller firms, therefore, the apprentices should be under the care of a senior official, preferably a director, and the departmental foremen taken into the confidence of the Management, their interest invited and sustained in the apprentices, and reports of apprentices' progress should be just as carefully dealt with in the small organisations as it is now in the larger ones. Where the nature of the business makes it inconvenient for the youth to have a full range of machines, then by co-operation with other firms in a similar position, an exchange of personnel should be arranged. I cannot emphasise too strongly the importance of inviting the foreman's co-operation. I have known students presented with the option of working overtime, or going to night school and losing their jobs. This can only happen if the Management fail to enlist the support of the foreman and make allowances for the presence of the apprentices in the shop.

Speaking on general welfare in the shops, here again the large firms have the advantage inasmuch as they can, with relatively small expense, supply amenities and facilities for their apprentices, even to the extent of separate washing and changing rooms. This should be extended, as far as is humanly possible, even to the small Works, and personal pride need not be sacrificed by the youth undertaking dirty work. Furthermore, the operation of the five-day week and the later leaving time at night means that the student should be in a position to leave work clean enough to go direct to school.

As to the details of actual training in the workshops, this will depend largely on the nature of the industry and partly on the scope of the apprenticeship scheme, but whatever the scope and whatever the nature of the work, the underlying principle of the instruction should be that of quality and pride of craft. I think we would all agree that these early impressions and early reactions to treatment in the adolescent stage have a profound influence on the outlook of the grown man.

Technical Training. (a) The Student.

Now let us turn to technical training. The raising of the school-leaving age this year to 15, and later to 16, will be a costly failure unless these later two years, which previously have been spent in the work-shop, or at any rate in Industry, are properly and efficiently used. And this depends again on the type of teacher and the school curriculum of the last two years. I would dare suggest that 15-16 is perhaps the most impressionable period in a man's life and one reason why there has been a drift to black-coated occupations has, to my mind, been the influence of the teacher of the boys in the last year of school. This has been intensified by the scholarship system, transferring a boy to a grammar school where, on the average, the knowledge of Industry, its opportunities and its importance to the economic life of the country, are almost unknown, and where the main urge is to earn more scholarships and to get as many students as possible through to the University, without having a heed, either to the actual tendencies of the boy, or to the needs of the country. It was a bad day for Industry when the Junior Technical Schools were submerged by the Grammar Schools, and it is encouraging to note that under the new scheme of education an equivalent has been reinstated.

I emphasise, therefore, the importance of these extra two years at school. The present system of what has been wrongly called " taking the cream off the milk " and sending it to secondary or grammar schools has been entirely wrong. It is more important to find the trend or the natural aptitude of youth than it is to attempt to segregate them by their capacity, or otherwise, for passing examinations. A large part of the time available by this extra period at school should, therefore, be devoted to instruction on the structure of Industry, the co-relation of the various industries, the nature of the work performed in these industries, and by handicraft classes, investigating the natural trend of boys, whether it be in manipulative skill—and this may vary—or whether his mind is more active or more pliable than his fingers. It is wrong to suggest that if his mind is more active at that time, that the boy whose fingers are more nimble is, therefore, less intelligent, but this has been the case in the past and it has had an unfortunate effect on the entry into Industry of valuable labour. You may say that a boy is too young at the age of 14, or even 16, to choose what he wants to be, but how can he choose if he doesn't know what there is to do ? And does he have any choice, anyway ? If he happens to be " skimmed off " with the " cream ", he gets pushed into the academic stream by scholarships and by the desire of his master to get good examination results, and if he is left behind he is pitchforked into any job, usually by parents who are more interested in what he is likely to bring into the household coffers than they are in what kind of a citizen, husband and father he

is likely to be when he has to look after himself. I submit, therefore, that it is more important, in these latter two years at school, that he should know what his country makes, what he can do towards helping to make these products, than it is for him to know what Gladstone said in 1863.

To this end, I would suggest that arrangements should be made with local Industries for periodical visits to the Works, instruction given on the products made, their uses and their destination, with particular emphasis on commodities intended for export.

It is not too early at this stage, by handicraft classes, to instil into the boy pride of craft and pride of achievement by allowing him to design and produce small articles which can be taken home, and by penalising the careless boy by the withdrawal of this privilege. When the school-leaving age is raised to 16, work now undertaken by the Junior Technical Schools such as more advanced handicraft, Engineering Drawing and Elementary Geometry, can be included in the curriculum. In the meantime, this work could be carried out by part-time education, so that at the age of 16 a boy would be at such a stage that he could complete the Common Engineering Certificate by the age of 18. Working on the basis that the Board of Education have agreed that five-eighths of the day per week release from industry to the County College shall be spent on vocational education, I would suggest the following syllabus :—

1st Year ...	Workshop Calculations	1 hour.
	Hand Sketching, introduction to Solid Geometry	2 hours.
	Workshop Science and Handicraft ...	2 hours.
	English	1 hour.
	P.T. and personal hygiene	2 hours.
	plus one evening class of 2 hours—Elementary Physics.	
2nd Year ...	Mensuration, more difficult calculations, Gear Ratios, Screw Threads	1 hour.
	Hand Sketching, Machine Drawing, Solid Geometry	2 hours.
	Workshop Science and Practice	2 hours.
	English (Industrial History line of pioneers)	1 hour.
	P.T. and personal hygiene	1 hour.
	plus one evening class of 2 hours—Mechanics, or other part-time study.	

For the wider details of such a syllabus, I cannot do better than refer you to the paper presented by Dr. Fisher to the Association of Technical Institutions in 1930.

Apprenticeships will normally start at the age of 16 and my own feeling is that a Common Engineering Certificate should be the aim to cover Electrical, Mechanical and Production Engineering. The basis of this certificate (which should, with the extra day per week at school, be attained in two years with night school or other part-time study), should include the commodities, the tools and the wherewithal of production. To my mind, one might as well try to train for, say, the medical profession without a knowledge of biology as to train for the engineering profession without a knowledge of materials, the manipulation of those materials, and the needs of production.

This Common Certificate should be dealt with and approved by a Joint Committee of the three technical institutions ; thereafter the boy should be allowed to specialise in any of the subjects he desires and from then on his training and the supervision of his work should be controlled by the appropriate Institution. I know this is controversial—that is what it is intended to be ! I know that there will be criticisms of lack of standards, of the descriptive rather than the example—but let us get out of our minds once and for all that the ability to remember formulae in Physics or the Adiabatic Law is a greater mental attainment than the ability to pick up a drawing and lay out a complete programme of production. It is this attitude of mind that I and many stalwart members of the Institution of Production Engineers have been fighting for the last 15 years, ably supported let me add, by many far-seeing friends from the Technical Colleges in the country.

A short time ago, a Principal of a Technical College was very concerned as to the ability of some of his students to make the grade of the Ordinary National Certificate. They were students from Elementary Schools and it was agreed that these students should be transferred from the National Certificate Course to the City and Guilds where subjects of a more practical nature were dealt with. They made the grade, and more than that, once having appreciated the correlation between their work and their studies, the Principal is now hopeful that they will also make the grade for the Ordinary National Certificate. We are not all made alike,—it's as well that we're not—and I would be the last to suggest that every individual, if trained sufficiently long, could reach the highest academic attainments. I know that I never should ! So let us keep our feet on the ground. I am suggesting the two-year course for its universal value, as a basis, because it is of interest to, and will therefore be understood by, the boy whose main bent is in manipulation rather than in mental gymnastics. The fact that he can, in parallel with his workshop training, undertake further studies within his grasp will whet his appetite for more advanced studies. It may be, however, that his particular mission in life is in physical production but he won't thereby have been debarred from winning a certificate of national

standing. Furthermore, all grades of apprentices will have had a common, basic training, giving equal opportunity to all.

He will know more about his job and about the tools he is using, and why certain methods of manipulation are essential. If he remains a craftsman he will be a better craftsman for that ; if he is of the type who prefers mental gymnastics, he will have gained by knowing what his calculation is all about, his vision for design will have been widened by the knowledge of the materials and processes available. If he has both the manipulative skill and the ability to think beyond feeds and speeds, then he will become a Production Engineer, and again, the two years of training on the basic product of this Industry will be the correct foundation on which to build his further experience.

Dealing with the Production Engineer, let us assume that the two year Certificate is accepted, and examine in a little more detail the kind of syllabus and the period that should be devoted to further study. I would suggest the following :—

Higher National Certificate (*Production Engineering*), 3 *Years.*

1*st Year*	...	Production Processes. Engineering Drawing. English. Practical Mathematics.
2*nd* Year	...	Production Processes. Jig and Tool Design. Optional Subject.
3*rd Year*	...	Jig and Tool Design and Motion Study. Industrial Administration. One optional subject.

There is a wide choice of subjects for this Higher National Certificate and this choice will vary according to local Industry, the size and facilities available at the local Technical College, and with the inclination of the student. Among these optional subjects are :

Metrology.
Metallurgy.
Application of Electricity to Industrial Processes.
Machine Tool Design.
Plastics.
Press and Sheet Metal Work.
Welding Processes.
Hot Stamping and Forging.
Foundry Practice.
Time and Motion Study.
Industrial Administration.
Production Control.

Many of the above-mentioned subjects are self-explanatory, and complete within themselves, but I would make one or two observations on those which are least defined. In Metallurgy and Electricity, for example, the aim of the syllabus should be to present the subject to the student in such a way that he will obtain sufficient grasp of it to use it as an aid to his main job, rather as an addendum than as a foundation. For Time and Motion Study, the selection of the teacher here is most important—the object of Time and Motion Study should be to increase efficiency all round, not to reduce wages. This important aid to production has become suspect because of the unscrupulous way in which it has (in isolated cases, maybe,) been applied in the past, and perhaps now the most important factor in time study is to obtain the confidence of the operator. It is fair to say that operators who have been technically trained are far less likely to be suspicious of time and motion study than those to whom it is a complete mystery.

Of Production Control, I would suggest that this important subject be treated as a fundamental aid to production and not as a means of keeping printers and paper merchants working overtime.

If the student desires to go beyond the Higher National Certificate, then I suggest that subjects recommended in the Report of the Sub-committee on Education for Management should be introduced. In that excellent report, reference is made to the varying forms of managements, and the final course could be built up from six subjects prescribed by the appropriate professional institution, together with management principles and management practice. It is suggested in this report that the age of students entering upon this course should be 28 years minimum, leading to the final examination at 32 years, in general management qualification.

(b) The Teacher.

In my opening remarks, I indicated that before such schemes could be embarked upon, it was necessary to attract youth into Production Engineering. Another most important factor is the obtaining of the correct type of teacher.

It is said that teachers are born and not made, and whilst it is important that they should know their subject, it is more important that they should know how to put it over, and that they should be kept abreast of the times. If Rip Van Winkle had studied with Archimedes and were to wake up today, he would still be able to teach Archimedes' Law, but the same cannot be said of Production Engineering. Most Production Engineers could say "Eureka" almost daily at new methods and new short cuts devised and developed in their daily round and common task, but since their vocabulary is usually of a slightly different kind, their exclamations will not go down to posterity.

It is important, therefore, that having found a teacher of the right type, he should be kept abreast of the times, and of movements and developments in production technique.

There are two fields for recruitment, the full-time teacher and the part-time teacher. The full time teacher should graduate from Industry, and local Works should make it possible for him to spend periods in the factory for refresher courses, from time to time. These periods should be organised and not haphazard, they should be part of a planned scheme. This will not only keep the teacher abreast of the times and of new developments but it will also keep Industry interested in Technical Education.

As to the part-time teacher, Industry should take a benevolent view of this and encourage those of their technical experts who have the flair, to undertake part-time teaching as a national duty. In any case, the remuneration for the effort involved in this important task is not likely to attract others than those who enjoy the work. I believe that the "powers-that-be" have at last awakened to the futility of expecting teachers in non-academic subjects, who have no academic qualifications, to accept responsibilities under non-Burnham scales.

(c) College Equipment.

Time does not permit a detailed survey of this very important factor in technical training, but the need for a few remarks is indicated. Whilst I do feel the importance of keeping machines up to date, the old-fashioned machines should not be entirely left out. Owing to their simplicity they are very useful for demonstration of the principles of the machine tool and the mechanics of screw cutting, together with feeds and speeds.

On the whole, however, modern machines should be available, particularly in the workshop, as the tie-up between the day-school lecture and drawing-office instruction. Arrangements might be made with the machine tool Industry to have a "float" of machine tools, particularly if the Chancellor of the Exchequer would make allowances to the machine-tool makers for machines out on loan to Technical Colleges. These could be periodically released, before the machine-tools were too out of date to be of value as a saleable article, and the Company reimbursed for the difference in value.

The major difficulty in Workshops is to avoid the impression of "exercises", and wherever possible work should be of a useful nature, preferably associated with the equipment required in the college itself, since very few colleges are in a position to undertake work for disposal outside.

On the Metrology side, the installation of metrology laboratories at specified colleges, is I think, already under way, and facilities should be available to the more advanced students, in colleges without

this advantage to take their Metrology courses at those schools where the laboratory and equipment are available.

I feel that my remarks have been somewhat sketchy, but I feel sure that you will agree that it would be impossible in the space of some 45 minutes effectively to cover the full scope of one of the sections, *i.e.*, Technical Education, Works' Training, Training of Teachers, or College Equipment—each of these subjects justifies individual treatment in a paper equally as long as the one I have given to you—but the main object as I understand it is to promote thought and discussion on this very important subject, and maybe others better qualified than myself can now take up the threads and fill in more detail with the many phases of technical education for production.

In conclusion, I would add that we are passing through perilous times. We have weathered one threat of extermination only to introduce another by doing so, and if this country is to remain a first-class Power, then all thoughts of abnormal profits, and of restrictive practices—up to now somewhat encouraged by Trade Unions—must be set aside, not only now but for all time, and the way to do this to my mind is by an impressive scheme of education run in parallel and in co-operation with practical training, for only by such means and methods can we obtain and preserve the full, material understanding between the craftsman, the foreman, the manager and the director.

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MAN-POWER GROUP.

"THE UTILISATION OF MAN-POWER"

By H. BRIGGS, B.A.(Cantab.), B.Com.(Lond.).

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Mr. N. ROWBOTHAM, C.B.E., B.Sc., F.R.Ae.S., M.I.P.E.

(*President of the Institution*)

(Mr. Briggs is at present Chief of the Wages Department with Messrs. Cadbury Bros. Ltd. Entering industry after a University training, he has given much attention to personnel problems and is Chairman of the Birmingham Group of the Institute of Personnel Management.)

Like Mr. Berry, I welcome very much the opportunity of reading a paper at this Conference, and may I congratulate your Institution on selecting for today's discussion such a topic as National Productive Efficiency—a burning question, if ever there was one in these fuelless days.

What I want to talk about is men at work.

Men are not Standardised.

Now, in taking delivery of a machine for installation in a factory, there is a lot an employer knows about that machine, even before he receives it. He knows that similar ones exist in other factories. He has no doubt been given a specification. He would have seen the machine in operation, and has been able to estimate working costs pretty accurately. Of course, he would have to bank on a certain standard of performance from the people running it.

In so far as the worker was tending a highly mechanised plant, the experienced employer might estimate labour cost within relatively narrow limits, since he might argue that the operative must produce in spite of himself, so long as he stands there and the machine or plant does not require any adjustment from him. On the other hand, if the process is such as to require a considerable degree of manipulative skill, and the output is more within the control of the operative, then the employer might allow a wider margin in making his estimate.

I said that the employer would bank on a certain standard of performance from the operative. But supposing the man working on the highly mechanised process is dissatisfied and clever, and knows that the time-study man is accumulating evidence on the basis of which he will piece-rate the job, then such an operative may interrupt the flow of material to the job, or allow the waste percentage to increase or reduce the effective running time by rest pauses other than those officially allowed, and by this means make hay of any

estimates which the employer may have made as to the labour cost of production on that process.

On the other hand, on the job where it is difficult to estimate costs because a large part of the job is within the control of the worker (for instance, the example I have mentioned of a job requiring high manipulative skill), the skilled man may be so interested in his work that sheer pride of craft will help to speed up output, even on a day-work basis.

These examples are generalised and exaggerated, but they do, I think, bring out the point that it is very difficult to talk of standardisation when one is dealing with men at work. We can try to measure effort by finding what is an average performance on the basis of time-study, but does this necessarily mean that performance will be realised if, for example, men feel—perhaps quite unjustly—that by achieving the performance which is set out for them, they will put some of their mates out of work, or that by playing for time they can get a higher piece-rate ?

Again, it is the function of a good Planning or Time-Study Department, when staffing a new job, to estimate the staff required, based on previous experience of similar jobs. Yet an employer will start up a department or a process, using the same number of staff, drawn from perhaps the same district, producing the same type of product as that in another department or factory, and he will not get the same results, neither will he get the same spirit amongst the work-people. There may be a specification stamped on a machine ; we search in vain for one on a new employee.

At this stage it is appropriate to utter the well-worn tag—" men are not machines ". This is not to say that in many ways men are not stereotyped in their behaviour and in their way of living. Such things as cinemas, departmental stores of a standard type, prefabricated houses, all help to create a common pattern of living. Within certain limits, we do know, too, what is likely to be the reaction both of individuals and of groups of individuals to particular situations and particular stimuli. We know roughly how a gathering of people at a greyhound track will behave, particularly if they think that the result of a race has been arranged beforehand. But can we say, when an employer or manager walks into a factory, just how that particular collection of work people will behave ? When we interview an individual, can we always say before we see him what will be his reaction to certain situations ?

In order to use men for work and to get the best out of them, it is important to find out what they are thinking about work, how they judge the effort they will give, and for what objects they think the work is being done.

Background to Industrial Relations.

To attempt to find answers to questions such as these demands some knowledge of the back ground. Events have happened in the past which have conditioned the minds of today's working force. In one industry there is bitterness and frustration and a feeling of rebellion against both employers and responsible Trade Union leaders because of unemployment and distress in past years. In another industry, an aggressive Trade Union, flushed with success at its war-time efforts in securing improved wages and conditions—probably long overdue—is still pressing claims on employers, and is possibly ignoring other and more responsible work directed towards completely reconstructing that industry for its post-war job.

I think there are certain trends which have taken place in the last two decades and which might, perhaps, be mentioned as having some effect on a worker's reaction to his or her job.

First, I think there is the very great improvement in working conditions. A factory inspector would be better qualified to speak on this topic than I, and each Chief Inspector of Factories Annual Report pays testimony to this immense improvement in factory conditions. In one year's report it is an improvement in safety devices ; another year, the progress of canteens is underlined ; another year, reductions in hours of work for women and juniors are recorded. This is not to say that there is not still a good deal to be done in such subjects as for example, the study of posture, in lighting, and in air conditioning of work-rooms, but anyone who has worked in industry for the last twenty years (and in particular, anyone who has moved from a small factory of the bad type to a modern factory), cannot help but be struck by the great improvement in the conditions under which he works.

Second, there is the institution of a minimum level of security. The National Insurance Act has laid down for every employed man a subsistence income below which he will not fall, and this has had the effect of diminishing the fear of losing his job. On the other hand, the fear has not been removed, as I think we have seen during the weeks of the fuel crisis, when there has been a noticeable atmosphere of doubt as to whether men who have been discharged will be able to get regular work again, even though during their unemployment they have been in receipt of the dole, and even though the dole is almost at the level at which National Insurance Act benefits would be paid.

Then there is the development of mass production and its sequel, the specialising of firms so that the whole industrial structure becomes more interdependent, and where the plan of production becomes inevitably larger and more complex ; where, unless the whole industry is in balance, motor car production stops for want of side lamps and bicycles for want of ball bearings. Here there are problems

caused by the disappearance of certain craft skills, and the attack on others. The power press puts the sheet metal worker on the defensive —rightly, as some think ; the coachbuilder is looking for work, and plumbing units are prefabricated.

Then there is the growth in the power and influence of the Trade Unions. I do not mean by this a growth in the numbers of members, since even today these are not very different from those reached after the last war ; but in their responsibility and power the Trade Unions of today are in a much stronger position than they have ever been before. The officials of the Trade Unions know this ; some of the members know it, others are indifferent. It is a factor which must be taken into account in weighing up the relationship of employer to worker, since it has brought about such things as the impersonal approach to a factory problem from the point of view of a Joint Industrial Council or a Wages Council, a widening of the field for Trade Union officials, together with the temptations that exist to seduce a good official away from his job in the pursuit of other activities.

Then indirectly, there has been a change in the ownership of industry. In those happy, care-free days when most businesses were small ones, and the owner knew personally every employee, then it was fairly easy for opportunities to be found for personal contact between owner and worker and for inducing enthusiasm. The position today is that, with a very large section of industry, the ownership is in the hands of shareholders, most of whom have probably never seen the factories of the companies in which they hold shares. This has set up in the minds of many workers the conception of having to work for some mysterious people who simply sit back and accept the fruits of their labours. It ignores the point that in many cases the shareholders are themselves workers who have invested, perhaps, their small savings in shares.

On top of this there is the present trend towards the nationalisation of certain industries, on the effects of which it is too early yet to say anything.

In another direction, namely, that of the control of a business, the worker has for the last two decades become more remote from the employer. This is an age of specialisation and of the functional control of business. In the old days the foreman hired and fired, did his own planning, his own piece-rate setting, and often his own wages calculation. Today, most of these functions have been removed from the foreman or supervisor—at any rate in the large business—and have been placed under specialists. There is now a Production Department, a Planning Office, a Piece-Rates and Time-Study Section, an Employment or Personnel Department. This has obviously had some effect on both the position of the worker in relation to management, and on the outlook of management itself.

The worker has become more remote from the top management. The official responsible for a function (such as the chief Planning Officer or the Cost Accountant) does not go inside the factory on to the shop floor, in the way that the foreman does. In some factories this even applies to the Personnel Officer, particularly if the personnel function is organised on the basis of a Central Labour Office covering a number of factories. There is some danger in this widening of the gulf between top management and workers, in that it is extremely difficult to get across points of view unless there is direct contact between the two. At the same time, a new opportunity is provided for the foreman and supervisor who, in many ways, is becoming the personnel officer of today, in the sense that only he, or she, can have the direct management contact on a day-to-day basis with individual workers.

Other disadvantages—and these apply more to the large business—are that physical movement becomes more difficult, and the mere fact that a factory becomes larger prevents officials responsible for company policy from making personal contact with workers, perhaps in remote parts of the factory. Even a decentralisation of production does not help very much, since this means that top management have to spend a lot of time travelling from one unit to another, and they tend to grow away from the problems of the shop floor.

Then, from another point of view, functionalisation creates disadvantages, in that it narrows the point of view of the specialist and sets up friction between one function and another. On the other hand, industry is getting more and more complicated, and demands the use of more specialised techniques. Perhaps the lesson we should draw from this is, that there is a need for balance throughout the organisation, and the necessity for not letting any particular section of it get too big.

Objectives of Industry.

So much for the background. Now, as employers, I imagine that we would put down very simply our objectives in industry as, on the economic side, a higher rate of production per employee. On the human side, it seems to me that what we want is an intelligent working population who are prepared to work. The economic aspect is measured in terms of cost, profit and technical efficiency. The human side is measured in terms of employee relationships; for example, labour turnover, tenure of employment, sickness and accidents records, wages, the happiness of a worker at his job.

Now, I do not wish to suggest by this category of terms that one can weigh up the human side by mere statistics. To the extent

that we may not get a standard quality of work, I suppose it is true as well that we cannot evaluate the economic side by merely counting the pieces which are produced.

The Formal Pattern of Employer-Worker Relationships.

Assuming that we, as employers, have got our ideas clear as to our objectives in industry, the next question we have to ask ourselves is whether we are satisfied that the machinery exists for carrying out these objectives: secondly, whether the same objectives are in the minds of the workpeople; and thirdly, whether the workers feel as strongly about them as we do.

Arrangement of Work.

From the aspect of production, there are certain things which we do which call for examination from the point of the utilisation of labour. The first and obvious one is the arrangement of work. Now, this is primarily a problem of planning—of fitting labour into the production scheme with every man in his right place.

Are we satisfied that, generally speaking, our planning arrangements are as efficient as we can make them? And by "efficient" I mean from the point of view of labour productivity. Where there is an out-of-balance of production, do we, if we are, say, working day and night shifts, let the night shift always carry the out-of-balance, and have we ever thought of the reactions that this has on the attitude of the workers to their job? I mention this specific problem because it is one which confronted us recently in our own business. It came up as a question of remuneration. Men on nights were not obtaining the same piece-work results as girls on days, because they had not the opportunity of long runs, owing to the fact that whenever there was any adjustment of planning, they had to stand it. The best solution which we could devise was to try and get stability amongst the longer service people on nights by regularly planning their lay-out, and by letting the shorter service people take the variations. My point is that it is not enough, in dealing with problems of this kind, merely to tackle what is most efficient from the point of view of production. Sometimes, where there is a saving in cost in employing one type of labour instead of another, consideration of this point only will leave out of account intangible factors arising out of the disorganisation of labour.

In the example I have quoted, one of the issues arising was the question of women labour on days versus men labour on nights, and it required a delicate balance between men and women to achieve the most efficient all-round production. This is all the more important if we bear in mind the need for the staggering of shifts arising out of the fuel crisis.

Size of the Unit.

Now, as to the Shop. I am taking good lighting, ventilation, and such things for granted. But are we always sure that we have the right size of department? Are we in danger of thinking in terms of the large unit too much? Recently, I was in a factory which was previously a shadow factory and had been taken over by a well-known national concern. I was shown through the main shop. It was not full of machinery yet, because the place was being tooled up.

I was struck by the evident pride taken by the management in the very size of the shop. I could not help asking myself, however, how I should feel if I were a worker there, and my instinctive reaction was to say that I preferred working in a small, rather cosier department to the large super-barn where most of the work was done. I do not think we have given enough thought to the size of the unit. I think this same criticism applies to the size of a factory.

The trend, as we know, has been towards the large works. Recently there have been signs that this trend has changed, and that the very big concerns are thinking more in terms of medium-size factories distributed about the country. The reasons for this change, I think, may have little to do with the point I am making. They are concerned to some extent with the pressure put on industry by the Government to bring about a more even distribution of factories. My concern is as to whether, from the point of view of labour relations within the unit, the factory is of the right size.

I understand that plant designers in America are now working on the basis of a factory employing two to three thousand people, and not one employing twenty to thirty thousand. The type of process, the amount of space required, the number of employees per ton of output, are all factors in this problem. I can only put the point that in settling issues of this kind, we should bear in mind what would be an appropriate size for a unit which would ensure that all the factors are in balance, that there are means for proper joint consultation and of control and communication between the management and the workpeople.

This difficulty comes out in all sorts of odd ways. Recently we had an argument on our works council, because of the relative distances of departments from the entrance lodge and the fact that some sections of workpeople arrived later than others at the dining-room. You may say that the easy way to settle an issue of this kind would be to stagger hours, but this was difficult to do. It was a problem arising out of the very size and complication of the firm. In a factory of two thousand employees such a snag, which is quite a simple one, would not, perhaps, have arisen. In our factory the problem assumed large proportions, generated a lot of heat amongst

our workpeople, and obviously had some effect on the rate of output.

Control and Communication.

I now go on to the problems of control and communication. Here we are faced with the difficulty of the transmission of orders and accurate information, both down and up the organisation. I would ask employers what steps they have taken systematically to see that this transmission takes place. I am not dealing at this stage with the methods adopted for keeping the various grades of management informed ; I am concerned more with the effect on the workpeople. Obviously, if the management chain does not work properly, then the workpeople—sometimes directly, sometimes indirectly—are affected. It is astonishing how often workpeople are alive to a situation where their particular supervisor is left out in the cold. I would say to employers who wish to have good labour relations : "Make sure that your system of communicating orders and information is clear and is understood." The larger the business, the more essential it is to see that each section knows what is happening to the others ; that accurate information about the events affecting raw materials, sales and change in planning are conveyed to all officials in the business.

Next, we should ask ourselves what information we are putting over. The specialist functional controller tends to think in specialist terms. We must adapt our phraseology to ensure that it is understood by the people to whom we are conveying the information. The chemist must speak in intelligible language to the foreman; the foreman must speak in a language the worker will understand. A cost account statement is unintelligible to a layman ; overheads mean nothing to the operative.

Consultation.

Now for the question of shop floor consultation. This is a subject which has received a good deal of attention in the last few years. There have been various approaches to it via Works Councils, Production Committees, and direct consultation on the shop floor itself. Here again, simplicity and intelligibility are important criteria. Also, it is important that the method of consultation should be understood by everybody. More than this, however, employers must be less reluctant to pass on information which would convey to workpeople how their effort affects the cost of production, and so enables reduction in prices, larger turnover, and greater employment. This cannot, in my view, be done by exhortations on posters ; these are all right in their way, but tend soon to pall. It can, I think, be best done by consultation with responsible representatives of workpeople. I know the cry is raised that it is

impossible to find workpeople who are either responsible or intelligent enough to discuss matters such as these with the employer. In my experience this criticism does not hold water. There are workpeople in most factories who are capable of bringing an intelligent comprehension to bear on such facts as I have suggested should be forthcoming. I know that in this connection there is the criticism from some fellow-workers that their representative is in the management's pocket. The position of the workers' representative is not enviable. He has to represent his fellow-workers, and at the same time carry responsibility for certain opinions he has expressed, or sometimes decisions to which he has been a party. Yet I think it is possible to find good Shop Committee members, or Shop Stewards, or Works Councillors. Surely, a more educated Britain must produce more and more of these people, and the higher level of education will demand a more intelligent approach by employers to the problem of consultation in industry.

From the point of view of the individual at work, it has never been expected in the past that he should put forward proposals for the better arrangement of the job. There has been a tendency for management to say that it knows its own business best in this. A tentative approach towards enlisting the help of the workpeople in solving problems of this kind was made during the war, with the setting up of Production Committees. It is true to say, I think, that these Committees, on the whole, have not been welcomed by management. I think the reason is that management regard matters covered by these Committees—certainly those which affect production—as being matters for management settlement. They have been willing for Production Committees to deal with welfare problems, but have not been prepared to enlist the ideas of workpeople on the better arrangement and planning of the job except, perhaps, through a Suggestion Scheme.

Now, consultation is not management. At the same time, it can be very closely connected. The success of an employer in this modern age will often depend upon the extent to which he can reserve the final decision on problems of his business (which he must, of course, always do), and the extent to which he can hand out responsibility to a body of the Works Council type, or to a joint meeting of management and Shop Stewards. We have a highly developed Works Council in our business. Our Board are willing (subject to their final authority, which is very rarely used) not only on welfare and health matters, but also on rules and discipline in the factory and a wide range of other matters, for our Works Council to carry a great amount of responsibility. A Committee of our Works Council decides whether or not to withhold holiday payment from men who have not kept good time. It decides whether to impose penalties on men who have been guilty of breaches of the

rules. It is a forum for grievances, and in this respect it is on an equal standing with many such bodies in industry. Every attempt is made, however, not to put grievances in the forefront of the Council's work. We try to make it a constructive body, rather than a critical one. We take a great deal of trouble over the Production, Sales, and Employment Statements which are made at most Council meetings. It does mean that in cases where there is a difference of opinion, the management have to prepare a pretty good case, since it is argued with great force on both sides, and each side attempts to persuade the other. Sometimes a vote is taken ; often there is a real difference of opinion. Only on one occasion, in my experience, have we had an occurrence which has caused even a temporary suspension of the activities of the Council.

Remuneration.

As important to the employer as good planning and good control, and more important to the employee, is the question of methods of remuneration. Now, there is a lot that can be said on this subject. Hesitantly, and yet inevitably, the Government is being driven towards stabilisation of wages, which must be achieved if we are to maintain stabilised prices. Recent Government pronouncements have all been on this theme. The difficulty is that we should probably have to stabilise wages at their present relationships, which do not match the priorities which we want in order to attract labour into these industries where we need it. To approach the problem from the point of view of a national minimum for people in work, if there is a national minimum for people not at work, is reasonable, and some increase in wages over the national minimum to equate higher productivity is not only reasonable, but essential. And yet, how are we to achieve this and, at the same time, justify no increases of this kind, or smaller ones, to other sections of the community who may claim that their productivity is just as much increased ?

Increases of themselves do not always lead to greater effort. In any industry or firm where the stint exists, rises in wages, on whatever basis they are done, must be given with caution. There is a lot of educating to be done, and a lot of prejudice to break down, and this applies whatever the method of payment. There are advocates of time-work and advocates of payments by results. I am an advocate of payment by results. It seems to me that any employer, whatever system of wages payment he has, is faced with the problem of deciding what shall be his staff, and even on day-work he has to estimate for a certain number of men to do a certain output. In principle it is only one step from this to measuring output by a piece-rate. Of course, it is not as simple as this. Piece-rates often cause scamped work ; jobs worked on the one-off principle are impossible to piece-rate. There is the difficulty of taking accurate records ; there is the problem of restricted output.

These, in my opinion, do not invalidate the simple truth that a worker who sees he can get more by increased effort will, generally speaking, try to get it. There is involved the question as to what he can spend his money on ; that is one of the difficulties of to-day. But in our experience, as a firm, we have always found payment by results essential, particularly on jobs which depend upon the man's own effort.

Summing up the present situation, it seems that the Government's exhortations to refrain from pressing wage increases will be continued, but schemes of payment by results will be encouraged in all trades. These will have to be very carefully framed with reference to the quality of the product and the measurement of the work. It has always seemed to me that one of our weaknesses here is that there is no common standard of time-study and piece-rate setting. I do not mean by this that jobs which are common in an industry should all carry the same rate. Each job has its own conditions which must be studied. There can, however, be a common standard for training of time-study men.

In this respect, the Trade Unions have as yet got nowhere near the standards of competence in time-study matters which has been achieved by management in industry. It will be argued that in any case it is not the Trade Union's job to do what management should be doing. Only the other day, a prominent Birmingham industrialist said that it was management's job to manage, and not the shop steward's. Obviously one must agree with this, but none the less it is all a question of the approach to relations in industry. Is there any reason why Trade Unions should not bring a more intelligent comprehension to bear on time-study problems ? Surely the first step to doing a job is to know it, and at the moment the Trade Union officials often do not know it. In most factories Shop Stewards obviously have more of the detail than senior officials of the Union ; yet the latter are so harried by pressure of work, and have so many commitments in such a wide variety of industry in their districts, that they are quite unable to deal with the intricate detail which confronts them in disputes and negotiations for a particular factory. They ought to be able to sit down with the time-study department and express opinions as to whether, from their experience of other similar operations, the staffing and the effort required is fair. There should be Trade Union time-study experts. These should not be tied to a particular district, but might well deal with an industry. I can never understand why a Union like the Transport and General Workers' Union sets up an elaborate organisation, prides itself on the quality of its Insurance Department and of its Education Section, and yet does not come down to the hard facts of life so far as industry is concerned, which is higher productivity per head. It is no use setting up production committees on a national level when what is

required is intelligent comprehension of the problem on the shop floor. I suppose the Trade Union attitude is still based today on the defence of workers' rights against employers, rather than the more constructive problem of maximising production.

The Individual and the Informal Group.

I have dealt so far with the formal organisation of industry, but this leaves out of account a very great deal. Because we conduct our business through a chain of control, or by means of consultation with certain individuals, we must not fall into the error of believing that by this means we are dealing with all the various factors which are in the minds of the individual workers in the shop. One of the difficulties of today is the fact that the representative of the workers sometimes does not represent, in the sense that his fellow-workers are often prepared to break away from him, whether it is a Trade Union organiser or a Shop Steward, because they feel that he has either not adequately stated their case, or he is not conscious of their particular problems. This is as much a social problem as any. We are concerned here with such influences as the jealousies between different groups of workpeople ; Trade Union versus the unofficial Shop Steward ; the question of men's work versus women's work ; clerical status versus factory status ; night men and day men.

Now, I do not wish to suggest that there is always conflict between these groups, but certain terms acquire meaning ; for instance, " married women " and the " white-collared staff ", and so on. Moreover, the pattern is continually changing. A new supervisor will alter the attitude of the workpeople in that department, to the management and to the job. The introduction of a batch of new labour, owing to the process being extended, will perhaps bring in a strong ex-Service element. A small labour turnover may mean a gradually ageing staff. All these are factors which mean that one's appreciation of the staff in a particular section of the factory must continually be adjusted to the ever-changing make-up of the group.

Again, a lay-out may be arranged in a certain way. Workers may be asked to take certain places in the lay-out, and yet it may be found from experience that they tend to form themselves into groups which, while informal, conduce more to efficient production than those which have been laid down by the management. There are reasons for all this, and it is the job of management to find out what these reasons are. I am not sure that the lay-out from the engineer's angle is always the best lay-out from the point of view of human relations.

Some years ago, we altered a method of production which involved teams of four taking work from a feeder belt and finishing the work as small teams, and we planned for teams of two partly to finish the job and throw it back on the belt for completion. At the end of the

belt a very large additional team would finish off the work. This was objected to, and the grounds were several, but I think that running through the whole problem was the conception that we had altered what, in the minds of the operatives, was a reasonable-sized working unit. We had, in fact, upset the social balance of the department.

We are all living under the shadow of the events of the past few weeks, which we can now see to be the worst production crisis which we have faced for twenty years. Nothing in the war—not even the worst of the bombing—has produced the dislocation which we have witnessed since the announcement of the power cuts was made in early February. Our production will recover, but we shall feel the effects of this stoppage for some time, and it is important for us to weigh the consequences from every angle, but particularly from that of its effect on the workers of this country. Are the events of the past few weeks, as some have said, " a blessing in disguise " ? Will they produce a Dunkirk spirit ? On a lower plane, will the fact that workers' incomes have been reduced stimulate them to greater efforts to make up their money ? If so, will this come by extra overtime working, or by higher piece-rate effort ? What will be the effect on recruitment into those industries such as coal, where there has been steady work during the present close-down ?

We do not know what is going to be the reaction on our own particular industries and individual firms. We do know that the immediate reaction on work-people who have been out of work for over three weeks—whether they have been in receipt of unemployment benefit only, or whether their firms have made them payments —is one of enthusiasm at their return to work. So far as my own firm is concerned, I think this was undoubtedly the case last Monday, when our people started back. A sense of loyalty to a firm is a great thing in itself for inducing enthusiasm amongst workpeople, and I think that in these times of rationing where there is a target to aim for in an industry producing, say, a rationed commodity, one can place a definite objective in front of workpeople, and point out just how far the fact of being unable to work has meant that we have fallen behind in producing the ration.

The same sense of urgency could be struck in connection with the export trade—and I am thinking now of motor-car production particularly. It is very necessary that the Government should give a strong lead as to what is expected of us in order to make good the damage which has been done to our economic structure. I am not making any comments as to how far the latest White Paper goes towards this. What I do feel is that, while the Government should play their part, it depends as much upon the efforts of the communities which make up the many factories in the country, and the success with which they can achieve an identity of zeal as between boards of directors, management and workpeople in reaching their common purpose.

MAN-POWER GROUP.

JOINT DISCUSSION

Chairman:

Mr. N. ROWBOTHAM, C.B.E., B.Sc., F.R.Ae.S., M.I.P.E.,

(President of the Institution)

The Chairman was supported on the platform by the Right Hon. Lord Sempill, Mr. J. W. Berry and Mr. H. Briggs.

Mr. J. E. ATTWOOD asked whether Mr. Briggs considered the present constitution of the J.P.C's to be the right one, with particular reference to the method by which members were elected.

Mr. H. BRIGGS replied that they had not a Joint Production Committee at their own factory, although they had had one on the engineering side during the war. As he understood it, the workers' representatives on those Committees were trade union nominees—elected shop stewards, or sometimes trade union organisers. He believed that the election of workers' representatives from the body of the workpeople was the right way to get the workers' nominees.

The great difficulty was to get good people on the Committees. If often happened that the people who came on to such Committees and on to Works Councils were the discordant element, and sometimes the ringleaders ; one did not always get the wiser people. Sometimes breakaway factions were not represented. He believed in the method of election, however, and also that the members should stand periodically for re-election ; they should be given the chance of going back to their constituents for re-election from time to time.

Their own Works Council was not a Joint Production Committee, in the sense that there were no members from outside ; all the members came from inside the business. The workers' representatives on that Council came up for re-election every two years. They could go on for a long time if re-elected, and some of them had been on the Council for twelve years ; but by means of re-election the workers' side was, so to speak, refreshed by contact with their constituents, and the constituents were given an opportunity of turning them out if they were not satisfactory.

Mr. ATTWOOD said that in the main as at present constituted he thought that the Committees were useless when they had a political or trade union background. If the workers' representatives were elected from the shop floor, without being associated with the trade union, one might get a number of first-class skilled men who would be much more useful on the Committees than the present members.

Mr. J. W. BERRY agreed, and said that as far as his own Works Committee was concerned (representing now about 1,500 people, and during the war about 3,000) he had always insisted that the

trade union tag was not to be a condition. It depended very largely on the structure of the firm, on the growth of the firm and on the average period of employment of the workers. Where there was a group of people who had been with the firm a long time, who understood it and who had an interest in it, he thought that the Works Production Committees could be very useful as a safety-valve.

He found them disappointing, however, when it was necessary to "get something over" which was not altogether pleasant. One had to take human nature as it was, and the workers' representatives on the Committee were scared of being called "gaffer's men."

Mr. GALLINGTON raised the question of dispersal factories which had been located in non-industrial areas. In one instance with which he was concerned, he said, there were no facilities for technical education reasonably near at hand, and in addition the factory was not producing an article which made it possible to give very much training in school to apprentices; the only departments in the factory which involved skill were the tool-room and the maintenance department. In a case of that kind, how should the apprentices' training scheme be tackled?

Mr. BERRY said that it depended very largely on the product and on the nature of the apprenticeship scheme. The case mentioned seemed to be one for a "sandwich" scheme of apprenticeship. The works which he had the honour to represent instituted a sandwich scheme three years ago whereby four months of the year were spent in the technical college full-time (so that the question of distance did not arise) and eight months in the factory. The eight months were spent in different departments, but in each year the apprentice spent one period in his parent department, the tool-room or the drawing-office. That seemed to be the only way out in such a case as that cited.

Mr. T. G. BAMFORD (Wednesbury Technical College) said that Mr. Berry had given a detailed account of his suggested syllabus of training, but would be aware that compulsory part-time education up to the age of 18 was envisaged in the Education Act of 1944 and that it was proposed to have county colleges for that purpose. Those county colleges would not be technical colleges, and would not be equipped along the lines which Mr. Berry had in mind. One was being started at Bilston at the present time, and would be the first in the country.

Mr Butler, the former Minister of Education, when they met him in London, suggested that the building of these county colleges would take a long time, and that it might be better to do the cultural part of the education in the existing technical colleges. Personally, that idea appealed to him very much. When, however, the new county colleges were established, they would be semi-cultural institutions which the young people would be obliged to attend. Would firms be willing, in addition to the two half-days a week at the county college,

to let their young people undertake the kind of education which Mr. Berry had in mind ? It would mean three or four periods for the type of training which Mr. Berry envisaged and two half-days for the county college.

Personally, he thought that it was all wrong, and that the education of youths from production firms could be carried out in the technical college, adding English to complete the training and satisfy the requirements of the Act. That was a matter which would have to be decided by the Government in the near future, and an expression of view by the present meeting would be worth while.

MR. BERRY replied that it was specifically for that reason that he had put forward his proposal in the form he did. As far as he knew the opinion of industry, they would not agree to one day per week in the county college under the new compulsory scheme and an extra day per week for technical training. That would leave, with the five-day week, only three days a week in industry ; and Sir Godfrey Ince had explained that morning what the position of boys entering industry was likely to be in the future.

If the training was to be done properly, five-eighths of the period of one day per week must be spent on really progressive education allied to industry ; otherwise it would be an absolute waste of time and mean a reintroduction of full night-school training, which he had always deprecated ; moreover, there would be less desire on the part of the boy to go to night school, having spent an extra day a week in school on a compulsory basis. He held strongly that the vocational part of the training should be done under the supervision of the organised technical college, if the equipment and teaching staff were not available in the county college.

MR. BEASLEY disagreed with Mr. Berry's view that a boy should be 18 before being allowed to earn money by an incentive, on the ground that most boys were called up at the age of 18, and that before they joined the Forces they should be made to understand that what they earned in industry was due to their own sweat and toil. They should therefore be able, he maintained, to earn their money on their own for a year or two before being called up. They might be given some help in the form of a factor, or something of that kind, but they should realise that what they earned came from their own work.

MR. BERRY called attention to the agreement that where youths were undertaking an organized training scheme they would not be called up until they had finished. Whatever the case might be, however, in his view it was wrong to put a boy on pure incentives, as distinct from training, at too early an age.

MR. BRIGGS, dealing with his Works Council, said it was a question of what responsibilities management was prepared to share. One might say that it was the job of management to do everything and to make every decision—to tell the worker what would be done

about his holiday pay, to listen to his grievance and settle it in a way which would be final, and so on. It might be possible to run a business very successfully on that basis ; but where one had an intelligent body of workpeople—he did not claim that theirs were more intelligent than others—it was desirable to find some method of interesting them and making them face their responsibilities.

For over twenty years they had had a holiday scheme which as part of its conditions had provided extra days of holiday if time-keeping and service generally had been satisfactory. On the question of time-keeping, they had found from experience that it was perfectly possible for a joint committee of representatives of management and workers to review cases where people had been late or absent without permission and to withhold pay. That meant that the individuals who committed the offences actually lost money, and that not only the management but the workers through their representatives on the committee said that they should do so. It might be thought that as a result the workers' representatives would be unpopular in the factory and would refuse to undertake responsibilities of that kind, but they had found that that was not the case. The system had worked for more than twenty years. A worker with a bad record might suffer a loss of up to about £7 a year.

On the question of discipline, they had a tribunal consisting of a representative of the workers, a representative of the management, and a foreman from the foremen's list who happened to be on the Works Council at the time. That body had the power of discussing breaches of the rules which were bad enough to be brought before it. There again it might be thought that that was a function of management. If the case was bad enough, the management reserved the right to discharge, and the workers respected that right. The management did discharge in very bad cases, but other cases of breaches of the rules came before the tribunal, and it had been found to work satisfactorily. The worker who was on the tribunal had to face a certain amount of criticism from his fellow-workers, but it was not always the same worker, and in practice the scheme worked ; there was no serious objection to it on the part of the rest of the men in the factory.

MR. MASON referred to what Mr. Berry had said as to the influence of snobbery when a boy was starting out in life and was advised to go in for a white-collar job. They had all suffered from that in one way and another, but he would like Mr. Berry's advice on how to deal with the boys and their parents when speaking to them on the subject, and how to persuade them to get the lads to go into the works and see things for themselves.

MR. BERRY said that there were two aspects to the matter. First, the really skilled and trained craftsman was not so subject to fluctuations in trade as was the half-baked and even the white-collar

man, and a really skilled craftsman was capable of earning better money than the white-collar man ; his conditions were tending to improve. The second aspect was that of the national interest and national requirements. Unless there was a great entry into the productive industries, this country was going to lose its standard of living, and would find it hard to live at all. Those were the two main lines.

There must also be a lead from above. One found juvenile employment bureaux advising boys against entering heavy industries, because it meant hard work. A crazier and more short-sighted policy it was impossible to imagine, yet that had been happening in Birmingham. Those people must have their knuckles rapped from the officials above, and must be taught that an unbalanced industry was just as dangerous as an unbalanced mind.

MR. BRIGGS suggested that if by "white-collar jobs" the reference was meant to be to a clerical job as against a factory job, the position to-day was that most of the clerical work was going away from the men who used to do it to machines which were worked by girls. In his own factory and those with which his firm was associated, the intake of young males into offices was very small indeed, but the intake of females was very much heavier, because so many office jobs to-day were done by machines. There was a diminishing number of jobs for the youth whose parents were anxious to get him into an office. Even the banks and insurance offices were taking more and more girl labour and less and less male labour.

MR. CHANTRILL said that Mr. Berry had emphasised the need for technical colleges to have a more occupational outlook on what they taught, and seemed to suggest that their equipment was out of date. Personally, he thought that there was a little danger there. If the technical colleges were expected to teach all the up-to-date processes, they could not possibly cope, in an area such as Wolverhampton, with all the developments in all the firms in the engineering and other trades. It seemed desirable, therefore, that the colleges should teach the principles. When a new process embodied a new principle then was the time for the education authorities to take it up ; otherwise he felt that that must be done in industry. The same considerations applied to equipment. Old equipment, built on first principles, was better adapted for teaching those principles.

MR. BERRY pointed out that in his paper he had said that whilst he felt the importance of keeping machines up to date, "the old-fashioned machines should not be entirely left out. Owing to their simplicity they are very useful for demonstration of the principles of the machine tool and the mechanics of screw-cutting, together with feeds and speeds." It would be difficult, however, to hold the interest of the senior students with old-fashioned machines, and

that was why he had suggested a "float" of machine tools, not necessarily involving heavy and continual expenditure, and had suggested that the Chancellor of the Exchequer might help.

MR. WORTH mentioned that there were certain firms who were now prepared to lend machines on the basis of a yearly payment of, say, 10 per cent. of the cost, and who would undertake to replace a machine by a new design.

DR. W. E. FISHER (Wolverhampton Technical College), said that in the Wolverhampton College there were four machine tools of a certain make, and it was up to the manufacturers to see that they were never out of date. There was an arrangement by which they gave the College two months' notice, so that they did not come in the middle of a term to take a machine away and replace it. He wished that that were more widely done.

MR. NEVIS suggested that the production engineer was more and more arranging machinery and processes so that some simple method requiring only unskilled or female labour could be used. He wondered whether sooner or later that source would dry up.

MR. BERRY said that the point was where the "hewers of wood and drawers of water" were to come from. He thought that the answer lay in the variations in human nature. There would always be boys and girls, whatever was done, who preferred the entertainments of life to any serious effort to improve their own status, and, sad though it might be to contemplate it, he believed that there would always be sufficient of such people to do the repetition jobs. The aim of the production engineer should be to remove the need for effort, and so things would tend to balance themselves.

MR. GALLINGTON remarked that what Mr. Briggs had said seemed to be concerned mainly with the worker and management. Nowadays, there seemed to be a tendency towards the training of foremen for general supervision along the lines of T.W.I., instituted by the Ministry of Labour. That should be followed up by having a foreman's association. He used the word "association" because it should not be regarded as a union, but would be purely an association. If Mr. Briggs had gone into the question of T.W.I. it would be interesting to have his comments on the connection between the intermediate grade between the top management and the actual workers and the J.P.C. There should be a link, he thought, between the two.

MR. BRIGGS, who remarked that the question was a very good one, said that one of the difficulties to-day, particularly in big business, was that the foreman, unless very great care was taken, was going to resent the type of set-up which was being introduced. Reference had been made to the J.P.C., and regard might also be given to the Joint Industrial Council as being something even more remote from the factory and the foreman than the J.P.C. In flour

milling, the J.I.C. had discussed such questions as apprenticeship and industrial hazards, questions with which the foreman came into intimate contact. It was necessary to be very careful to see, therefore, that the foreman, who was a vital part of the management, was not left out in the cold.

What could be done ? T.W.I. had been excellent if only because it had put the foreman back into the picture ; T.W.I. was a refresher course, in many ways, for foremen. It gave the foreman the sense that his function was a vital one in industry, and that he was part of the management process. T.W.I., as he understood it, was addressed specifically to the foremen. In so far as the general set-up which he had described in his paper was concerned, under which the top management became more remote from the worker in the shop, the foreman had a vital part to play ; in many ways he was becoming the personnel officer of to-day, and he was doing that because he was in intimate contact with the men, and because many of the functions which he used to perform had been removed from him—plant, the fixing of piece-rates and so on. Care must be taken to keep him in the picture in other ways and see that he was well informed, and it was therefore necessary to have a foremen's association and a foremen's meeting.

In his own firm, they took great pains to have a foremen's meeting and to see that it followed on immediately after their Works Council meeting. At the foremen's meeting, certain policy decisions were reported, the same policy decisions having been reported at the Works Council meeting. The production manager would attend the foremen's meeting by invitation of the foremen's association, which had to preserve its status and issued its own invitations. They were told, "If you care to invite the production manager, he will tell you about the policy." That gave them a sense of status in the organisation.

Where there was a Works Council or a Joint Production Committee, some of the foremen should be put on to that. Unless men from that level were put on, a vital part of the management machine would be unable to take any part in the joint consultative machinery. If there were shop committees, the foreman would be made chairman of the shop committee, so that he had the running of his own little community. It was imperative in such ways as those to see that the foremen got a square deal.

MR. BAMFORD, dealing with the question of a two-year or three-year National Certificate course, asked whether Mr. Berry felt strongly on the question of the two-year course and was really a convert to it. Personally, he had grave doubts on the subject. He found that generally the main wastage occurred in the first and second years ; both in the first year and in the second year, about the middle of the session or soon after it started there was a big

falling off. On the other hand, when a man got into the third or National Certificate year he usually stayed for the whole of that year and took his National Certificate. That seemed to be a serious objection to cutting down the length of the course. Was Mr. Berry only half-converted to the idea, or had he strong feelings about it ?

MR. BERRY said he did not know whether it would be accurate to call him a convert, but he believed that with the five hours a week, plus one hour evening or part-time, an ordinary National Certificate of no lower standard than the present one could be obtained in two years, and he thought it more important to spend a longer period on the more specialised line of study for the Higher National. He had spoken of the ordinary National Certificate, but he had in mind a certificate which would be equal to the ordinary National Certificate and which would be common to the whole industry, craft apprentices as well as engineering apprentices.

MR. BAMFORD said he did not think that it could be done.

MR. BERRY replied that in his view it could, but he welcomed the fact that Mr. Bamford had questioned it, because the matter was of paramount importance and had already been the subject of serious discussion by principals and other representatives of technical education. He would like to hear Dr. Fisher's views about it.

DR. FISHER said he did not think it was possible to get away from the fact that the entrants were going to be of mixed quality ; they were not all going to be the same in intellectual power and so on. At present a great number of lads leaving secondary school obtained admission to the second year of the ordinary National Certificate course and actually did it in two years, so that they would take the National Certificate examination at the age of 18. He thought that it would be a shame to put a stop to that by insisting on a full three-year course for people who perhaps did not need it. Again, military service was going to make it very expedient that the age of 18 should be a definite marking-point.

The position in that respect was a little difficult, because of the application of apprenticeship deferment. That was a concession, but it added to the difficulties, because some people would go off at 18 and some would stay until later. The better student had normally been able to get a National Certificate of the traditional type at about the age of 18, and should continue to be able to do so.

The big problem which would have to be faced, and in which he thought that industry would have a deciding voice, was the sharing out of the task of training between the technical colleges and the new county colleges. The Engineering Institutions had been laying their plans to fit in the ordinary National Certificate courses before the age of 18 on the assumption that there would be an interruption by military service, and obviously those Engineering Institutions

had assumed that, as at present, their part-time day students would be in attendance at technical colleges, properly staffed and equipped to conduct courses of the kind now associated with the name "National Certificate". Under the Act of 1944, however, that could be done only if those colleges also staffed and equipped themselves to add those subjects of study which were made compulsory (and properly so) under the 1944 Act.

His own college was doing so gradually. They were getting together physical training staff. They had recently appointed a man in charge of general education, as distinct from technical, and so on. It had always been their policy that the men who came to them for specific technical studies should as far as possible find also a place for proper association with their fellows, a place in which other doors were open. Under the spur of the new Act, which made it possible to spend money in those directions, they were trying to bring themselves in line, so that a student, and particularly a part-time day student, who entered for a course leading to the ordinary National Certificate would automatically have included in his course those subjects which the Act of 1944 was going to make compulsory.

One might say "Why not carry on like that, and let the technical colleges do the county college work?" That, however, would mean an enormous expansion of technical colleges, and it would mean that they would have to deal with some very difficult material. At the moment, those who came to the college had either elected to come, which meant that there was "something about them" or had been sent by employers, who would send only those worth sending. The technical colleges could not carry on if they had to take 100 per cent. of the population at the age of 16. Those who would have to take 100 per cent. would have a very difficult task. Where there was a centre of interest, where one had boys who wanted to be engineers, one had something to start with and something which would spur them on throughout their training. Mr. Brigg's firm employed people who did skilled work which they were taught on the job, and which nobody else could teach, and which did not make much demand on their intellect. It was a very good thing that a firm employing people of that type had also done pioneer work in framing a scheme of education for them.

The Education Act of 1944 laid it down specifically for the first time that education authorities must take responsibility for this part-time education, which must include a minimum of physical training and of general education. As for the rest, the Act was silent. That was all right in a way, because the silence implied that where the job was being well done the people concerned could go on doing it. If his college was able in a year's time to say to the Minister of Education, "Here are these people taking National

Certificate courses who fulfil the requirements of the Act," he did not think that anybody would interfere; but so far there was nothing in black and white to determine just what an education authority must do. There was nothing in the Act to prevent an education authority insisting on all these young people going to a general county college, and making the technical college start at 18.

He thought that the attitude of industry was going to be a determining factor there. When the matter was gone into, it would probably be found that there were more categories than had been thought whose jobs gave scope for training for knowledge. While, comparatively speaking, the technical colleges had an easy task, the county colleges would have a much easier one where there was such a central focus and where the job could help to impart interest to the course; but where the job did not impart interest to the course there was a new and very difficult educational problem, though that was not to say that it should not be attempted; it was more important for that group of people than for any others.

If, within the next two or three years, good part-time groups were got going in the local technical college in the particular field which was of importance to those concerned, he did not believe that there need be much fear of interference. If the work done in the technical college helped industry and at the same time satisfied the legal requirements of the Act, he did not think that anybody would interfere with it.

MR. GRICE, on the question of incentives and training, said that Mr. Berry wished to keep people away from incentives until the age of 18, and personally he would go further and say until the age of 21. Mr. Beasley's remarks, however, had shown the trend of thought among managers and top management generally; especially in view of the production drive, they wanted to get boys on to production as soon as possible. He would like to ask Mr. Berry how best to impress upon management the value of training.

With regard to selection, did Mr. Berry believe in psychological tests for selection, and how far would he go in having a selection organisation for selecting apprentices?

MR. BERRY, dealing with incentives, said that from an idealistic point of view he would prefer the age of 21 rather than 18, and mentioned a case which had occurred in his own works, where a boy who had been top boy at the junior technical college came in as an apprentice and got on to piece-work, with the result that he was on the same job to-day and would never get any further—a waste of good material.

So far as converting industry to believe in the importance of training was concerned, he felt in his bones that industry was at long last converted. The first world war started the process, and the second rammed it home. Organised industry, as represented,

for instance, by the Engineering and Allied Employers' Federation, was seriously considering the matter. He had spent a great deal of time on various committees dealing with selection and training, and that was why he had been so definite in replying to Mr. Bamford, because one conference with the trade unions and the Ministries of Education and Labour nearly broke down on that very point. He felt that industry as a whole was now appreciative of the importance of training.

With regard to psychological selection, whilst he agreed that the Institute of Industrial Psychology had done some very good work, he did not entirely trust selection by purely psychological means, and would prefer a period of trial with the boy. That could be done so long as the school-leaving age remained at 15, but if it was extended to 16 the position would become rather difficult and there were likely to be a few misfits. It was a case for careful watching by the apprentice manager, getting the true reaction of the foreman and the manager. That could be done only by personal contact, and not by relying on written reports. He had seen instances where glorious reports were sent in on an individual who happened to have good contacts, and it was only when it was almost too late that it was found that those reports were wrong, and that the boy in question was in fact playing about and not learning at all. Personal contacts, therefore, should be superimposed on any forms or written reports, and that would help to avoid misfits.

As long as the school-leaving age remained at 15, there was a year in which to sort out the boys and find the true reactions. That was one important value of the apprenticeship school. He had been opposed to an apprenticeship school in the past in his own organisation, but it could help in sorting out the boys and getting to know their interests and strong points before they got too far set on their course.

MR. BAMFORD, who moved a vote of thanks to the two speakers, Mr. Berry and Mr. Briggs, and to the two Chairmen of the Group, Lord Sempill and Mr. Rowbotham, said it had been suggested earlier that the Man-power Group was the Cinderella of the Groups, but if it was once the Cinderella of the ashes it soon became the Cinderella of the coach and the white horses, because it had certainly attracted a numerous, interested and informed audience. That was due to the speakers and the Chairmen, and therefore made his own task an easy one.

In view of the fact that Mr. Berry covered every possible phase of the subject of training, it was remarkable that he had been subjected to so little cross-fire. Apart from the questions of the age at which payment by results should begin, the best equipment for technical colleges, and whether the course for the ordinary

National Certificate should be two or three years, there seemed to be general agreement with all that he had had to say, so that obviously he had put the case perfectly.

Personally, before leaving that question he would like to emphasise a point which Dr. Fisher had made, namely, that at the present time there was a serious difference of opinion, as had been brought out by Mr. Butler, the former Minister of Education, on the question of building priorities—whether to go on building new county colleges or so to enlarge the existing technical colleges along the lines that Dr. Fisher had suggested, with facilities for physical culture, and so on, as to make them able to deal with employees of the engineering and technical type in conformity with the Act for the whole of their training, so that a smaller number of county colleges would be needed. Should enough county colleges be built to deal with the whole of the adolescent population, or should the facilities of the existing technical colleges be enlarged to deal with the needs of all those requiring vocational training? If Mr. Berry and others would keep that point in mind, and if the Institution of Production Engineers would express an opinion upon it, it would be very helpful at the present time.

Mr. Briggs took a totally different line. He dealt with a different aspect of the subject, and seemed to be emphasising a fact well known to sociologists for some time—that if organisations failed to meet the psychological needs of the individual and to enlist the souls of the men whom they employed, the emotions of those men turned sour, restlessness started in the factory and increased productivity became impossible. Mr. Briggs then went on to analyse modern trends and how they could be met. Trends changed. It might not be possible to change the ideas of society in one's factory, but it was possible to study the trends which existed and bring out those which one desired should prevail. Mr. Briggs brought out very well the problem of the treatment of man-power along the lines of current thought.

MR. WORTH, who seconded, thanked the speakers for so ably answering the questions put to them.

The vote of thanks was carried with acclamation.

MANAGEMENT GROUP.

"SOME PROBLEMS OF MANAGEMENT"

By W. C. PUCKEY, M.I.P.E., F.I.I.A.

Chairman :

Mr. F. C. WHITE, M.I.P.E., (President, Birmingham Section).

(Mr. Puckey is a Director and General Works Manager of Hoover, Ltd. He is an authority on Management, a well-known writer and lecturer on the subject, and in 1937 won the Institution of Production Engineers' Gold Medal for a paper. During the war he served on various Ministry Committees, and more recently on the Hosiery Working Party.)

The recent national crisis prompted me to scrap my prepared talk in favour of immediate issues, but a re-reading of my notes convinced me that the conclusions I had drawn would be just as applicable to our present situation as to the "Fool's Paradise" period of a month ago. It is not necessarily the solution which alters ; rather the sense of urgency induced in doing something about it. One only hopes that panic crisis will not produce only panic remedy—the actual solution is much more fundamental.

What *is* the principal management problem ? Is it food, queues, women who are emancipated in almost everything, or men who are realising that they are in many cases doing women's work ? Is it a problem of managers or workers, under-employment in South Wales or over-employment in the Midlands, nationalisation or free enterprise, coal or electric motors, exports or imports ?

Many have decided that the need for increasing production is today's problem although when discussing it most of us assume this to mean an increase to our own standard by the other fellow. It is the integration of our many superficial problems that we seek, and unless we find an objective acceptable to most investigators—one that can be expressed in fairly simple terms, we cannot hope to concentrate sufficiently on its solution. We cannot hope, also, to convince the many that the solution is right and is applicable to them.

Basically, while it only takes us a short distance along the road, the main problem of management, as with every other activity, is firstly to establish reasonable standards of measurement against which to compare performance. It is today's problem that many of our apparent human difficulties are aggravated by negative complaint rather than positive comparison, and as Lord Balfour once said "most people fail because they don't know the goal they desire to reach."

Within the space of a short paper I cannot amplify this belief, but I might sum up my approach by stating that the fundamental

problem of management is that of creating standards of measurement which in approximate arithmetical expression, include man's highest common factor as well as his lowest common denominator.

In the field of engineering an efficient mechanism can only be produced if each component part is produced within "limits". Taking this mechanical parallel it seems to me that each individual citizen has upper and lower limits of value. A real trouble is that we tend to measure his actualities against the lower limit without regard to the upper, largely because we do not appreciate where or how high the upper limit is. Unless, therefore, you have a clear view of man's potentialities, as represented by this upper limit, you cannot achieve what might be called Human Quality Control. It is not enough to state that God and the Devil represent these limits; they must be broken down into measurements applicable to many situations and activities, just as the individual parts of our mechanism have their own appropriate limits. Before attempting a solution you must know what you want to achieve. As *The Economist* said recently in relation to the Transport Nationalisation Bill, "nobody knows how much good there is to do".

The scientific approach to managerial problems does not differ from a similar approach to the more material problems, and an essential part of it is:—

1. To decide what performance you want.
2. To be able to measure it.

I believe a brief examination of our more superficial difficulties today will convince us that, taking a simple analogy, the selection of materials, the manufacture of individual parts, the assembly and testing of a simple engine, is a very much more scientific job than the selection of the individuals, training, the grouping together and measurement of performance of the people who make that engine.

A Systematic Analysis of the Problem.

If we compare the scientific approach to management problems with other such approaches the first thing striking the observer is the greater amount of opinion in relation to fact. Let us take only one example—the ideal characteristics required to make a good factory manager. Every answer will vary considerably. An answer on the chemical formula for benzine will be precise and comparable. Do we think we shall ever state our human requirements in such precise terms, or do we feel that man's capacity for infinite change will make a precise forecast of him impossible? Do we think that, having defined him, he will follow the pattern? In my working environment I often feel the task is hopeless and only in the meditative quiet of study do I sense fully his infinite

capacity for greatness and the rewards of unleashing man from his own bonds greater than anything the world has yet seen. Glimpses of his upper limits are occasionally seen, only to be dulled immediately by mediocrity, but enough gold has been seen to continue blasting the rock and refining the ore.

Now if we talk of management we must firstly define what it is before we attempt to solve its problems. Perhaps they would automatically be solved if we really knew, as managers, what we are driving at—what our target really is.

What is this Management ?

I have classified three principal kinds of characteristics which should be possessed by managers in varying degrees. In order of importance they are :—

1. Personal.
2. Organisational.
3. Technical.

It is difficult to envisage, over a short period, any marked change in the broad level of personal characteristics, which include such factors as intelligence, jealousy and courage. Special conditions, such as war and shortages, may throw emphasis from time to time on the best or worst sides of our nature, but generally fundamental make-up varies little over a long period. It is the utilisation of innate quality, or as Dennison puts it : " Control of the animal, the savage and the child in our mind " that is of greater immediate importance ; briefly, the necessity to organise our own personality, and its relationship to others.

On the technical side in many spheres there is really no serious problem over the near future, strange though this may sound. There is a vast fund of knowledge in the world, and as the late Lord Stamp said, the problem really is to use effectively what we already have. There is, for instance, a vast amount of production engineering experience not yet applied fully in this country.

The real possibility of the immediate future lies in the remaining characteristic—ORGANISATIONAL, because this alone will enable us effectively to harness together the first and third for personal and common good. The study and the application of organisational principles represents the third stage of the Industrial Revolution.

What is Organisation ?

There are many definitions, and I will give you three only. Mooney and Reilly define it as " the form of every human association for the attainment of a common purpose ". Mannheim

defines it as "the application of technical conceptions to the forms of human co-operation". The third definition is my own; it is "to arrange the parts so that the whole shall act as one body". You will notice that the first and third definitions lay stress on action or attainment, which is often lacking in many managerial definitions.

The scientific conception of organisation has permeated but slowly through the masses and even through the managers. People talk of the "machinery" of Government—a wrong term. A noble lord said recently in relation to two large groups that "the mechanical difficulties of fusion were great". The difficulties were in the field of organics, not mechanics. Possibly organisation is more difficult to isolate, study and popularise than the other characteristics of Personality and Technology; and the attitude of mind to it may be illustrated by one simple example—the Organisation Chart. It is interesting to go into a business and at an appropriate moment ask about such a chart. How often have I been told, usually by top management, that "we don't need those things here—we all know what to do". There is often a confusion and frustration among the lesser officials which is expressed more forcibly.

And yet it is so natural for people to use a map when exploring new terrain; to use a drawing when manufacturing something. The organisation chart is such a map or drawing, applied to the arrangement of people—the most difficult arrangement of all.

It is in this sphere that the scientific approach becomes so evident—or otherwise. So many managers feel that personalities cannot be arranged on paper, and I would be the first to agree if it remained there. If, however, the organisation can be expressed clearly on paper it is more likely to be understood clearly by those within it—and understanding is an essential step to achievement. Organisation, dealing with the relationship of people to people—up, down, and across—is a study which should be scientifically approached, the principles isolated and tested and finally permeated more effectively through all interested in management. It will, by its tendency to avoid overlapping, underlapping, frustration and wasted effort, enable both personal and technical qualities to be utilised more effectively "for the common purpose". You have only to watch two teams at tug-of-war where, with weights equal, the better organised one has "its parts acting as one body" to witness a simple example of the effect of good organisation.

To the trained observer nothing in a business is more significant than a map of its organisation. To the trained manager it is his first study when he wishes to change any person in the organisation, at any level; to introduce a new technique; to expand, contract, or promote. It is one of the most effective tools in his kit.

To design and use it he must have in his tool kit a set of organisational principles. As Fayol said, "the principle is the lighthouse which enables us to get our bearings, but it only helps those who know the way to port". "A manager knows that in technical matters he cannot depart from certain rules without risking loss of prestige. In organisation he often indulges in the most harmful practices with impunity."

Let us deal with a few problems which emerge from our study of the organisation chart.

Line or Staff—Which Comes First?

These are well-known to you as organisational terms. What may not be so well-known, because it is less appreciated, is the extent to which, in many fields, the staff function has gained status, unfortunately often at the expense of the line function.

From fifty years ago, when the owner or manager was literally jack-of-all-trades, responsible for buying, selling, making up wages, hiring and firing, promoting, and answering complaints, in addition to his fundamental job of producing, we have arrived at the stage where we have our purchasing and sales managers, wages, personnel managers, public relations officers, and even the job of producing has been broken down in many industries to a high degree of speciality. The direct worker has so many indirect helpers and advisers around him that he is in danger of suffocation. Worse still, he has disappeared so much from the public gaze, until recently, that he is suffering from an inferiority of complex and income, while his indirect friends take the limelight and other things. It is a fundamental concept of organisation as I know it that the line represents its real strength and must not be subordinate to the staff. Yet today we find this concept violated so often; the spectacular growth of personnel management has taken from many supervisors and managers their essential authorities and has been responsible for many problems of transition in its search for greater human understanding. The staff function of inspection or checking, whether of quality or quantity of work produced, has tended to reduce the responsibility of the line producer for these functions. The war-time growth of Joint Consultation in industry tended often to short circuit the line supervisor by making direct contacts between worker-representatives and top or personnel management. I heard recently of a graduate doing factory work who had been spoken to only twice in six weeks by his line foreman. The real boss was the ratefixer. The tendency to employ public relations officers in many fields will isolate the responsible line officer more effectively than before, with a further reduction in his sense of responsibility.

The staff may, and should, advise on both plans and their execution, *but essential responsibility remains with the line leader to plan and execute.* The true line leader knows the value of pre-digested thought and will take advice from all competent advisers—the better they are the better his final plans and performances are—but nothing should rob him of final authority and responsibility.

What are the results of the maltreatment of this organisation principle? In industry today we find those with better education, better training, better intelligence and potentialities being attracted to staff functions, and once in them, having the ear and the favour of the Directors. Following this, because big fleas have little fleas, we find a universal relative growth of indirects and overheads not only in the Civil Service but in Industry. There really wouldn't be such a shortage of labour today if staff functions were better controlled. One difficulty is that not all staff workers would, if released, take direct or line jobs, as their status would be reduced. Our job is to level by raising the line.

How important this is today. Let us look at a few statistics to impress it on our minds. I have circulated to all present some figures which have been compiled from official and other sources, with intelligent guess-work used where no figures are directly available. What does this analysis show? I can do no better than read you an extract from these notes.

(See Table on opposite page)

What Does the Analysis Show?

(*a*) That in spite of an apparent man-power gain in Productive Industry (4), we actually have nearly 110,000 *less* engaged today on *Direct Productive Work* than pre-war, owing to higher internal overheads. (7)

(*b*) That if we accept my estimated drop in today's productive efficiency we reduce direct man-power effectiveness by a further 550,000 compared with pre-war. (8)

(*c*) That achievement of the Government's export target of 175% pre-war will take nearly 500,000 more direct workers from Home production. (9)

(*d*) That the total reduction of 1,160,000 Direct Workers must invariably mean a considerable reduction in standard of living against pre-war. (10)

(*e*) That even a 5% rate of productivity increase (much more than pre-war) will take us over 4 years to achieve pre-war standards, let alone increase beyond it. (12)

MORE PRODUCTION—BUT BY WHOM?

The Man and the Jobs—An Analysis.

Category	1939		November 1946 *	
	Category total	Per cent. of total population	Category total	Per cent. of total population
1. TOTAL POPULATION	46,500,000	100	47,600,000	100
2. Under 15 and over 65 (not gainfully occupied)... ...	14,200,000	31*	14,639,000	30
3. 15 to 65's (not gainfully occupied — housewives, etc.) ...	12,600,000	27	13,000,000	27
4. Various Services, *i.e.*, Transport, Cinemas, Banks, Unemployed, Civil Service and Police...	10,900,000	23	10,700,000	22
5. Productive Industry *i.e.*, Agriculture, Mining, Building, Manufacturing	8,800,000	19	10,100,000	21
6. *Indirect* Workers (Part of 5 above)	2,640,000	30% of 5	4,050,000	40% of 5
7. *Direct* Workers* (Part of 5 above)	6,160,000	70% of 5	6,050,000	60% of 5
8. Effect of reduction in post-war efficiency*	... ...	... ...	5,500,000	
9. Effect of reduction in production for Home use, caused by attaining Export Target (175% pre-war)*	... ...	... ...	5,000,000	
10. Nett reduction in Direct workers on Home Production*	... ...	... ...	1,160,000 workers	
11. Per cent. reduction on pre-war	... ...	... ...	19	
12. Years to reach pre-war living standard at 5% increased productivity per year ...	... ...	... ...	Over 4 years	

* Author's estimates—other figures are official.

What to do About It!

(*f*) Increase the *number of people* on *Direct* production.

How?

(*g*) Reduce the National indirect—here are a few debits against pre-war (official figures for November, 1946).

	1938.	1946.	*Increase.*
National and Local Civil Service	1,385,000	2,032,000	647,000
Armed Forces	480,000	1,510,000	1,030,000
Entertainment and Sport ...	172,000	196,000	24,000
Ex H.M.F. not yet employed	—	345,000	345,000

(*h*) Reduce the internal Indirects by better organisation and management.

(*i*) Increase the status of Direct work so that greater numbers are attracted to its ranks.

(*j*) Continuous utilisation of technological improvements not only on direct labour but over the *whole range* of man-power activities.

Let us go a stage further. Those who work in industry are broadly classed as direct and indirect workers. There has been, as a result of the war, a general increase in indirect employment, and, naturally, as manpower has been limited, this indirect increase has been at the expense of the directs. Now I, as a manager, am more concerned with total cost than I am with the ratio of indirect to direct, but within reasonable limits of time this ratio is very important, and today our trend towards higher indirect is resulting in an even greater reduction in the number of those who are directly concerned with producing, whether coal, steel, or motors.

What is the remedy? As I have said earlier, let us strengthen the line function, and transfer our microscopic analysis of the direct worker to a search for greater efficiency and reduction of the national, local, and industrial overheads. There are today too many "overheads" and not enough "undergrounds".

By comparison let us look at the line members. They include the actual producers, the foremen, the deputies, the supervisors responsible for the principal function performed in the business, whether it be mining coal, making motors, or selling books. They are not being selected, trained, promoted and paid in accordance with their responsibilities. Promotion rarely takes place from staff to line functions, and the shop foreman who gets a job as personnel adviser probably finds both status and salary improved.

What is the reason for this relative subjugation of the line ? It lies, I believe, largely in the growth of centralisation, and I would like to spend a short time on this most important organisational problem of labour, which I will state as " the need for decentralisation ".

The Need for Decentralisation.

If we are wise we will plan towards a society in which it will become more difficult for a dictatorship to create and maintain itself. The Second World War was fought largely because there was no other way to finish the centralised dictatorships that had spread their destroying tentacles over the free minds of the people. Even before 1939, a slow but quite definite movement towards a centralised bureaucracy in this country was noticed by such men as the late Lord Hewart. Faint in substance perhaps when compared with the conditions in Germany and Italy, but quite definitely of the same shape.

When war actually broke on the world the process in Britain naturally speeded up tremendously. Centralised Government became more forceful, and with snowball-like effect produced Order upon Order to make itself, in the interests of war-winning, still more powerful. Now this was natural and necessary. What, however, was essential, once central " power " had been collected, was to decentralise it—delegate it to those who, outside the central zone, were still willing partners in the prosecution of the war. Now is not the time or place to discuss this subject further, but the Citrine Report on regional decentralisation under the Ministry of Production was an example showing the necessity of making use of decentralised authority and responsibility. Unfortunately, it was a few years too late.

So to the post-war world. The spectacle of a vast Government machine with all its knobs and levers in Whitehall is just as depressing and anti-social as the vast industrial corporation with all control, power and authority at headquarters and literal puppets at the fringes of the organisation. We should endeavour to give *authority* and its boon companion, *responsibility*, to the common man to the utmost of his ability to use his natural resources. That way lies full national vigour through the " integration of the individual "; the opposite way lies dictatorship and the subjugation of the individual.

If this is true of the large it should be true of part of the large. It should hold true in the individual company where, if the " infallibility of management " is an imposed code in the interests of a superficial efficiency, the full natural resources of the organisation are not utilised.

The growth of large-scale units, whether Government or private, has been largely responsible for the relative increase of staff functions and authority mentioned earlier; central authority, because it often fails adequately to delegate its powers, must surround itself with advisors, and the line function becomes less and less precise and recognized.

What practical steps can be taken to decentralise? Some might say "stop Nationalisation", but whatever our political views, we are all interested in improving overall efficiency of working and living, and there are many practical ways of enabling an individual to become identified with his working unit. We reach the "whole" through the "parts", and with today's national and international complexities, man must have a sheet anchor that he can see *near at hand.*

Therefore, the first essential loyalty and enthusiasm to build up is to the smallest group in which the individual works.

This must build up his enthusiasm to his department, his factory or office, his mine or his company. Only after these enthusiasms have been strengthened in turn are we likely to get him working for the wider objective of Coal Board or Country. So many men want to be proud of their working environment, they like working for an efficient foreman or manager—a good firm. How often we fail to capitalise on this trait.

During the war I was associated with considerable experience in decentralising our Company activities. We found many potential leaders who, in a small unit, could exercise leadership and produce grand results which simply would not have been produced so consistently in a large unit, neither would the satisfaction have been gained by leaders and workers. One of the most efficient factories was a converted garage, the supervisor in charge an upgraded shop steward. We organised opportunities for exercising their potential value.

One big problem of labour is under the heading of INCENTIVE. Do we have to have piece-work or payment by results? War-time experience convinced me that if the immediate leadership was worth-while, this method of payment was not particularly necessary, so long as individual merit on basic rate was fairly recognised. This simplification alone will reduce costs and staff functions considerably, although it will still be necessary to measure results against standards set, *in fact more so.* It will also reduce one of the biggest causes of resentment by line workers, and difficulties by supervisors who today frequently devote more time to maintaining total income than total production.

The real objective of decentralisation is therefore the simple one of stimulating loyalties, objectives and efficiencies from the smallest group upwards, instead of from the largest group downwards. If practical steps are taken to achieve this we shall find the line coming back into its own and central authority endeavouring to work itself out of a job, even if not out of its final inescapable responsibility.

One other of the many aspects of this section is worth commenting upon. How does joint consultation or worker-participation-in-management fit into our future labour structure? There really isn't much for me to say here. Surely, *all* managers accept fully the desirability of keeping all ranks informed on policy and performance as quickly as possible. Joint consultation, organised correctly, is a vital link in the chain of knowledge and satisfaction.

What about participation in management? In a considerable working experience of joint consultation, I have found that the demand of workers to take over management functions is in inverse proportion to the quality of the managers. The remedy is obvious. Many managers are leading today only because they are being chased.

The Significance of the Group.

I want to deal now with a most important problem—the organisation of group activity. The audience confronting me today behaves differently as a group than as individuals. The whole problem of life is working together, but what do we know about putting the right people together—of getting the best "combination" for a given task? Frankly, very little, and it is in this field that so much integrated research is necessary. It is here, starting with the smallest group of two, that we have "human association for attainment of a common purpose".

It is the fitting of the smaller into the larger group that is also our problem. How should we approach it? Should we start with the large group and work downwards, or should we work upwards? We may, of course, already *have* our large group. My own approach would be firstly to reorganise at the lower level; let us never forget that, with all the importance of the group, it must always be built up from the individual.

A recent writer suggested that groups were living entities, like individuals. Ingenious arguments were used, but in my view the conclusion was wrong. We must work upwards and attempt at all times to fit the individual accurately into the right place in the group jig-saw and not attempt to file too many corners off him in order to make him fit. Let us remember that within wide limits individual characteristics are the salt of the earth.

Are there any general rules of group organisation? I have a few, although I realise fully how little I know of this problem.

1. It should be as small numerically as is consistent with its task.
2. Its task should preferably be something well-defined, and be completed as far as possible to a recognisable stage of quality and quantity by the group.
3. Its geographic area should be as compact as possible.
4. Its leader-structure should comprise individuals having similar characteristics. A team of two fast-moving leaders would probably work better than two different types of individual.
5. Every opportunity should be made to create confidence by the group in its leaders.
6. A reasonable degree of job flexibility should be required of each member of the group, including the leader.
7. Methods of measuring and rewarding individual enterprise (or lack of it) should be set up within the group.
8. The organisational chart of the group should show clearly its relation to adjacent groups and of its individual leaders to other group leaders.
9. Its leader responsibility for authoritative decision should be as great as possible.

Number 6 is worth amplification. Job flexibility is becoming gradually less in this age of specialisation and restriction, and will cause many problems unless recognised. Every worker of every grade, from juvenile training onwards, should have reasonable flexibility of mind and job encouraged between functions, between line and staff, and between factories. Consider the possibility of building the shells of new houses in summer and finishing the insides in winter. How much difficulty would be met in organising such an arrangement and yet what possibilities exist. I wish time would permit other examples, but I can do no more than emphasise that with increased technical specialisation the credit is often reduced seriously by rigidity of organisation.

Just a few words also on Number 9. "Speed up the decision" might well be a slogan for all managers and the organisational effectiveness of any group might be measured by the shortness of the channel between enquiry and decision. Decentralisation must mean decentralisation of *authority*.

The Status of Industry.

The last of the few problems I wish to mention particularly deals with Status—or degree of standing in the Community. What makes men strike? Why do the great majority of strikes occur

among manual workers of the semi to skilled grades? Very largely, I believe, owing to an inferiority complex, a lack of status recognition.

The trend of the Industrial Revolution has relatively debased the craftsman in society and to be in industry at all has meant that you are not really in the top drawer. Let us take a few examples. How many promising students are encouraged to train for and enter industry? Most teachers, even today, are biased towards other activities. Industry is to them a suitable recipient for the "C's"—because no one else will take them. How little is the manual worker regarded in relation to the white-collar worker, even in the factory itself? The girl of 16 in the general office is probably eligible immediately for the company's pension scheme and other amenities. The highly skilled factory worker is out of them. The office worker has decent cloakrooms—the factory worker usually has either no doors or only half doors to his lavatory because he can't be trusted not to "mike"! He is still called a "hand" by many who ought to know better. His working hours are longer. Many other examples could be shewn but they all add up to the lack of status in society of the manual worker.

It might be thought that his good wages in many trades, his union backing, would tend to overcome this handicap, but on the subject of union membership alone this would almost seem statistically to be a direct factor in strikes as most strikers are union members, and many white collar workers regard union membership as a lowering of status, or at least an unnecessary adjunct of it.

There seems nothing likely to stop the sub-division of labour being carried over into other activities such as agriculture, civil service, office work, and selling, and many of the troubles of the industrial manual worker brought about by the introduction of the machine will spread to other jobs. There will be possible benefit in increased productivity, but this will be discounted by some of the current ills of manual industry. It will also involve a debasement of the present status of and satisfaction derived from those activities, so that the gap between social appeal of various jobs will narrow.

Unfortunately, this levelling by lowering is all wrong, and a more positive attempt would be to raise the present lower status of the industrial manual worker. Let us remember the vital nature of this task. My analysis shows that less than one-third of our total working population are direct workers; they are the people we think about when we talk of increasing production. Unless we increase their status they will get less and less numerically, and it will be impossible to increase their rate of output in order to maintain, let alone increase, our standard of living.

How can we attract people to their ranks ?

The unions have a major task here and their somewhat belated interest in production techniques is a step in the right direction, giving sponsorship to pride in the job in addition to pride in collective organisation and political strength.

Managers must, however, as always, accept prime responsibility. We must start by selling ourselves more effectively to those who don't know us—teachers, parents, children, so that a better cross-section of society is willing to start on the factory floor and work through. We must dig out our promotion channel from bottom to very top, so that promise is rewarded by promotion. We must strengthen the line function and the line supervisors, and in doing so we must endeavour in the future world of boards and councils to give more places to the direct worker representatives and those promoted to top rank from that source. We must endeavour through education and job rating to persuade people that skill through a trade has a value to society more comparable to other skills than it has at present. The term " dignity of labour " must really mean something. As was said by a Headmaster (Mr. Walter Oakeshoot, St. Paul's School) recently : " Education has meant hitherto something which the scholarly boy did well and the unscholarly did badly. We have tended to forget the man who was educated through his trade. The tradesman who has served a full apprenticeship has often received an education as good in its way as anything that can be provided in any school. For it brings not only competence in a trade, but also the full development of those faculties that are of use for it ; a sense of touch perhaps, and a sense of design, an exact appreciation of the quality of materials used, a precise awareness of the results likely to follow from given methods ; and with all this what might be called harmonising of the personality, and the acquisition of a steadiness and balance of outlook which never comes unless many of our faculties are being called into play ".

Last, but not least, we in industry must take even more active steps to educate our workers towards a broader conception of the business. Firstly, a greater contribution to the County College scheme of integrated Industrial/Educational activity among young people. Secondly, through joint consultation in its best sense, encouragement of wider outlooks and interests among all workers, to counteract the greater routine of the future and provide them with the work satisfaction they need. As working hours become shorter, this need becomes greater. Thirdly, more effective education and training of all grades to increase job satisfaction and performance. Last, but certainly not least, the fullest development of a pride in the leaders and *units* in which they work, and which I stressed in an earlier section.

The Managers' Acceptance of Responsibility.

Out of debate must come decision.

Out of decision must come fruition.

These axioms are more than ever significant today when initiative for finalisation seems at a low ebb. I mentioned earlier that an essential element in my definition of organisation was achievement or attainment, and one real shortage today is the initiative and courage necessary for this purpose. So much is known, so little *individual* responsibility for applying it.

I took a team to U.S.A. recently, and after intensive investigation we concluded that the acceptance of direct responsibility for decision and action was one of the biggest factors in their greater results. More people had an enterprising and alert attitude of mind, which resulted in more intelligent and effective working.

How many of your associates or subordinates can you really trust to carry through a decision to finalisation in good time? How many who put ideas to you instead of the reverse way? The problem of building such characteristics is great; it comes naturally to a few—in others it is often below the surface and can be brought out by some of the things discussed earlier.

There are at least three good ways of building up these characteristics. They are:

1. Setting individual targets.
2. Kindling individual enthusiasm.
3. Taking chances with the potential managers.

Let us deal briefly with them in order: I said earlier that one of our greatest management problems is lack of a measuring system, and so we come full circle to the great need for defining more closely what we want from people, not so much in mass, but individually. That is why the art of setting continuous targets is a managerial responsibility of the first order. There are many things to watch in setting them, but a few of the more important are:

(*a*) They should preferably be set in conjunction with those who have to achieve them.
(*b*) They should preferably include the competitive element.
(*c*) They should preferably include the time element.
(*d*) They should cover *all* grades of labour.
(*e*) The time element should be as short as is reasonable.
(*f*) They should be used to check performance and establish responsibilities.
(*g*) They should relate to individuals as far as possible.

Amplifying the last one only, a production target should not be set against a factory, a mine, or a department. It should be set

against Mr. Jones the manager, or Mr. Smith the supervisor. He in turn will set targets for Bill Brown and not No. 3 Group—and so on down the line. Each should personally present and explain his results, as part of his line responsibility.

How can we encourage individual enthusiasms? Once again by bringing things down to the individual as much as possible. We should avoid organisation charts having departments only stated, as is often done. The chart must be personalised. We must encourage individual suggestions and regard *each one* as a potential winner, not as a "sop" to joint consultation. We must encourage normal lines of contact. Let's speed up the procedure, not short-circuit it. We must show by example that promotion right to the top is possible to those who work for it. We must make a rapid two-way job of forming company policy, and not least, we must pay for individual merit generously without being intimidated by those who don't merit it.

And now for taking chances. One of the best ways to catch an epidemic is to expose oneself to it. Similarly, a good way to train for responsibility is to expose the person concerned to intimate and continuous contact with it. There are so many ways by which individual responsibility can be built up which are ignored today, and obviously the two last methods discussed will do much to help individually; indeed the whole theme of my talk has been one of emphasis on building from the individual upwards. Starting with the apprentice, we should make it continuously clear that we will match everything he does for himself, and we should allow him free opportunity for broadening the basis of his outlook, while giving him a first-class technical training to increase his own confidence and of others in him. We should encourage shop stewards to accept greater individual responsibility, which can only come if we broaden their understanding by sub-committee and other work which allows for reasonable *decision* to be made on many points instead of being purely advisory. Responsibility can only be built up with authority. We should insist that every supervisor and manager is individually responsible for his job, and if we do this no supervisor will worry much about joining a union which, by its nature, has sponsored collective security and action. If he does combine with his fellows outside, I hope it will be more and more in the direction of professional improvement, through such bodies as the I.P.E. Certainly, combination with his fellows inside should be by greater personal contacts and not by building paper bridges and mistaking regulations for management.

We will, I hope, give the supervisor and manager much better training in the future. It is significant to me that with all the talk of nationalisation, little is done to build the managers, their responsibilities and training. Perhaps it is assumed that they will just

fall into line. Certainly the manager of today is individually and collectively a small voice in the wilderness, and he might be pardoned, even after reading Burnham's "The Managerial Revolution", for imagining that today he is being robbed of his authority, even if not his responsibility.

Now, before I conclude, let me say that I and others have much to do before we achieve the programme set before us. Such a task represents my target, and I realise fully how much more there is to do. In other words, I know what I want to achieve, which is an essential ingredient of ultimate success.

Finally, we are supposed to be in the century of the Common Man, but let us never forget that it is the uncommon man also who should be recognised and reasonably encouraged. At least we should show him no more than the usual amount of resentment. We should try to build the Common Man up to the uncommon level, and not the reverse, and remember that, with respect to the multitude, the quality of a single man may be as a spring rising in the mountain which, once started along the right channel, may become in due course a mighty river of progress.

MANAGEMENT GROUP.

"MANAGEMENT—ANOTHER VIEW"

By LEWIS C. ORD.

CHAIRMAN: Mr. L. W. FARRER, M.I.P.E.

(Mr. Ord is an Industrial Consultant, and before settling in this country he had extensive experience with the Canadian Pacific Railway Co. Ltd. He has since held various executive posts in England, and has travelled widely on consultative work, assisting Governments as well as private firms. He is the author of "Secrets of Industry".)

Prosperity is a matter of work. The better the people of a nation work, the greater will be their prosperity. How much they can have of the things they wish to eat, use, and enjoy will be determined by how much they produce. The most prosperous nations are those that produce most per head of the population. Prosperity is primarily a problem in production. In fact, real prosperity for ordinary folk only started with industrial production.

No longer ago than 1814, the ordinary folk of this country were very poor. Agriculture was their main occupation. Unfortunately, the country had run short of good farm land. Much that was not suitable for the purpose was being farmed. The population, only about eight millions at that time, was increasing rapidly in spite of heavy emigration. Industrialisation was a necessity. More than forty million people could not have lived in these islands without it.

None knew better than the Government that industrialisation on the vast scale that was necessary was beyond them. Very wisely, they turned the job over to private enterprise. Having done so, they adopted the now famous policy of *laissez-faire*—hands off industry. Prices and wages had been controlled by Parliament on and off back to Plantagenet times. There was precedence for controls. There was pressure on the Government that they be applied. However, the Government believed that sharp and unrestricted competition in industry would achieve better results than any form of planning and control operated by the State or by any other body.

That policy paid. Private persons saved and found the vast sums of money necessary to industrialise the nation. It was done without cost to people or State, and to the very great benefit of both. In some sixty-five years, work was found for a population nearly four times as great, and the reward of all classes of the people had been trebled. There were no more people employed on the land. Industry, directly or indirectly, had found work for the rest.

The people of Great Britain had sound reasons for pride and satisfaction in their industrial position in 1880. Theirs was the

greatest empire, the greatest navy, and the wealthiest nation. Small as was their country, it was the most influential in world affairs. As individuals, they were wealthier than any others. London was the financial centre of the world. Their industrial supremacy was the foundation of these spectacular successes. The British production of real wealth per head of the population was the highest in the world.

Industrial developments had, by this time, become a race between the nations. In 1880, Great Britain led. She had led from the start. She was the favourite. The United States, close up, was in second place. Neither country held predominating industrial advantages. If, on balance, one was the more favoured, then undoubtedly Britain was that one.

No race ever fizzled out in stranger fashion. The reward of all classes in the United States rose with increasing speed right up to 1914. The British yearly increases grew progressively smaller. By 1913, they had ceased altogether. The British horse had ceased to run.

Examined in detail, the situation was worse. The ordinary folk in Great Britain and the United States were roughly three times as well off in 1880, as they had been in 1814. By 1914, the American production of real wealth per head had risen to about six times the 1814 level—the British to only four times.

These figures, which have been agreed by some of your leading economists, show that something had gone seriously wrong. It happened long enough ago, and that was of sufficient importance to the nation to warrant a thorough investigation. Yet up to the present, no clear explanation has been given to the people of this country of what went wrong or of how to put the wrong things right.

Then came the 1914-1918 war. Departing from the old tradition that politicians should be kept out of industry, a politician was put in charge. His first effort was to increase output—his second, to increase efficiency. The means used to accomplish the latter results was the introduction of more science into management, and more of what is now termed the planned economy—of Government planning and control over industry. The Government claimed remarkable successes in making British industry more efficient.

When the smoke of that war blew away, it became painfully apparent that Great Britain was in an industrial mess. The production of real wealth per head had not risen as had been so confidently predicted. It had fallen sharply. " After fifteen years of startling scientific advance, we have scarcely maintained the real income per head of 1911 ". So said the famous men who wrote the " Report of the Liberal Industrial Inquiry ", published in 1928.

The report confirmed the observed facts. In spite of hundreds of millions of pounds spent to improve the tools of British production, the output of real wealth per head had fallen sharply. From four times the 1814 rate in 1913, it fell to below three and three-quarter times in the early 1920's. This set-back did not have to happen. Someone had blundered, and had pulled the gear lever of British industrial progress into reverse. American production rose from six to six and a half times 1814 over the same period. Yet no one has taken the trouble to investigate and establish for the information of all concerned just what caused the British production of real wealth to decline at a time when it ought to have risen.

Then the Government got out of industry. Unfortunately, many of the mistaken ideas they introduced, such as the need for more figures and for more scientific management with more of planning, costings and control in industry, lingered. These ideas handicapped recovery. Even by 1939, the British production of real wealth per head reached only about four and a half times the 1814 level. American production increased from six and a half to eight times the 1814 rate. With all that leeway to catch up, British industrial progress was only at half the American rate. Once more, no one bothered to find out why.

Then came another great war. Again politicians took charge. Again they turned their attention to increasing efficiency. Again they claimed to have achieved wonderful success in this direction. Once more the people believed their tale.

The 1914-1918 war cost you fifteen years of industrial progress. Even in 1926, the production of real wealth per head was still down at the 1911 level. The last great war has cost you thirty years of industrial progress. Your production of real wealth today per head of the entire population is down to about the 1913 level. Yet how many people are aware of that fact, or of the reason ?

Gentlemen, I would like to stir you out of your complacency. By the end of this year, 1947, the average production of real wealth per head in this country is not likely to be higher than half American levels. Given the time, I could satisfy you that there is no reason why you should not produce as much real wealth per head as the Yanks. The balance of industrial advantage is yours. Your handicaps are almost wholly of your own making. Is it not time that a body like yours made a determined effort to get to the bottom of this problem ?

Look at the position of the country today. The volume of production for the Home market and Export is far too small. Prices are far too high. It is more difficult than ever to meet the competition of other nations for export. When this seller's market is over, how will you find the volume of exports you require ?

There are other reasons for worry. The people must be fed. A large proportion of their food must be purchased from abroad. There are many raw materials which this country does not have, and which must be obtained from abroad in order to keep industry going. It is impossible to purchase food, raw materials and other things except by exports. The exports are insufficient for the purpose. How are these things to be put right? The problem is peculiarly one with which you should deal. It is a production problem.

The usual suggestion is that the workers must work harder and produce more, and so save the country. The old statement is made that because prices are too high, wages cannot be raised. That is exactly what everyone was saying when I came to this country in 1920. Your workers will regard that call as the same old cry of "wolf", that they have heard so often before, or I misjudge them. That appeal will not work—it is not entitled to work. Let me present the worker's case.

Let us go back to 1880. British skilled industrial workers at that time were the most skilled, the most willing, and the most co-operative in the world. They were also the best paid. They were equipped with better tools than similar workers in any country, and they turned out more real wealth per head.

Yet long before 1914, the British workers had a grievance. They became convinced that they were not getting their fair share of the additional real wealth which they, as productive workers, actually produced. It was not mere suspicion. It was true. They were not getting their fair share.

They are in exactly the same position today. An average British productive worker is producing forty per cent. more, and probably fifty per cent. more than similar workers in 1913. Improved machines, tools and production methods are the reason. Yet the production of real wealth per head of the entire population is back to about 1913 level. Cost of living subsidies totalling more than £400,000,000 were paid last year to prevent the reward of the workers sinking to that level. Where has this additional real wealth gone? It was produced. The workers did not get any of it. Why?

You know the usual answer. The capitalists took it all to swell profits that were already far too large. On average, that tale is false. The capitalists were hit just as hard as the workers. Whoever got that additional real wealth, British capitalists did not.

Capitalists have a grievance. They saved and invested vast sums of money in industry since 1913. This was not done out of pure philanthropy. Their object was to increase their incomes. Most of the money they invested might as well have been poured down the drain for all the apparent good it has done them. Before taxation, they are no better off. After taxation, they have less.

Indignant at the smallness of their reward, British workers started to slow up their output rate long before 1914. It was a situation which the workers, as a class, were unable to rectify. I am glad to think they had the moral fibre to resist, even by slow working pace, rather than tamely to submit. The next move was up to the other side.

The capitalists did exactly the same. They went slow—but in a different way. They got tired of saving their money and investing it in British industry, when they got such bad treatment and such a poor return. The rate at which they invested money in the Home industries fell far below the level necessary to maintain the equipment of British industry up to American standards, for example. The relative fall in the rate of British production of real wealth per head due to this cause was probably fifty per cent. greater than the reduction caused by workers going slow.

Labour and capital were being deprived in ever-increasing degree of the additional real wealth which their joint efforts had enabled to be produced. Yet slow working pace and slow investment rate were both justified under the conditions obtaining. Yet had capital and labour put their heads together to find out who was doing them down, they must have discovered the culprits. Instead, they merely continued to snarl at each other.

Gentlemen, you are production engineers. There is probably nobody better able to tell the people of this country that the output of an average productive or direct worker has gone up in marked degree since 1913. You, and others like you, have been largely responsible for that increase. You have achieved notable successes in this direction. Where have these great gains gone ? Something has wiped out all the progress that the production engineers of Great Britain have achieved in the last thirty years or more. Now, gentlemen, do not laugh that one off and say it is not your responsibility. If it is not, then make it so. For how long are you going to permit other people's blunders to wipe out all the progress you have worked so hard to achieve ?

There are other questions for you to answer. Why should men born in this country work faster and more happily in the United States or Canada than they do here ? It is a fact. Until you put that right, you cannot cure the production problems.

As production engineers, I know you have all been bothered in the past because you have not been able to get the money you wanted to spend, in order to improve tools, machines, and equipment. Why have similar men in the United States been able to get the money they require to maintain their equipment to a very much higher standard ? Until you can get proportionately as much money to spend as similar American production engineers, you cannot cure your production problems. May I suggest that the

reason you have not been able to get pace out of your workers and money out of your capitalists is because neither of them has been given a square deal in the past ?

An American trade union leader who had spent many months in this country investigating industrial conditions, told me that it was in trade union policy that the two nations differed most. Another American, whose main interest was politics, told me that he could not have believed that two governments could differ so widely on industrial politics, if he had not been here for a long time studying the subject himself. There is a great deal in what these men said. I have been in this country longer than either of them. It is in management that I believe the two countries differ most.

Except for free trade and the sharper competition it produced, there was little difference in industrial policy or management between the two countries up to 1880. The men managing British businesses had been mainly men of the people—practical men who knew the business thoroughly from the bottom up. Offices were small affairs, and the people who inhabited them were looked down upon by the practical heads of the business.

After 1880, these conditions changed. Offices became larger and more imposing. They invaded the works and kept cropping up in all sorts of unexpected places. The men who inhabited them achieved a much more exalted status. In time, they came to look down on the lesser men who did not have offices, and in particular on those who soiled their hands with work.

In time, the rugged men who had built up these businesses wished to secure the succession to their sons. These sons were not prepared to start at the bottom and work their way up as their fathers had done. They preferred the pleasant experience of a course at a university, often in arts, and even in classics. They then wished to start somewhere near the top. None knew better than men who had battled their way up from the bottom, how important a thorough practical knowledge of a business was to its successful management. Many knew their sons did not have, and never would acquire, the practical part of that knowledge. They made a clever compromise to meet the situation.

A duplicate system of management was invented. Practical men were found who had all the knowledge that was necessary to run the works. They were given the title of works manager. The son, or other favoured appointee, after some training would be given the title of general manager and given authority over the works manager.

The result was the creation of two rival groups of offices, usually jealous and suspicious of each other. The General office and the Works office and all their staffs began to regard each other critically,

and to build up figures and statistics for attack and defence. So started a great game that goes on to this day. Under the old British conditions, and under American conditions, this duplication was not necessary, and did not happen. The efficiency of British management started to decline from this point, relative to American. Its cost and its elaboration increased steadily over the years.

Another point of difference is much more fundamental. Mass production started in the United States long before 1914. It will not be necessary for me to explain its advantages to production engineers. Yet, even in the United States, people were a long time in discovering that one of its greatest advantages lay in the tremendous saving in the proportion of non-producers that it made possible. Other points about the early developments of mass production in the United States would interest you, had we the time to discuss them. Mass production gave the world, and particularly the United States, the idea that increasing the size of a business was the best way to increase its efficiency. With this idea in the minds of the men at the top, it is not surprising that big American businesses grew bigger.

The dynamic personalities who were at the head of the larger American companies at that time insisted on keeping the maximum amount of control centred in their own hands. When the attempt was made to plan and control these big organisations in detail from the top, it put a great strain on the older forms of management. They proved inadequate.

Scientific management was designed and developed to do the job. Centralised controls were essential if the men at the top insisted on ruling in person. The new type of management, and the system by which it was operated, appeared to do all and more than was expected. The companies grew larger and more profitable. Credit went to the big company idea, of course, but even more to scientific management.

The big companies and their methods became steadily more unpopular with the American public. The Standard Oil Company was one of the largest and most profitable of these. Like the others, it was both centrally and scientifically planned and managed. It had a huge central headquarters to direct and control all its widespread activities. Headquarters was responsible for efficiency. This great central headquarters was the pride of the progressive within and without that great company.

The Sherman Anti-Trust Act was passed about this time, as a direct result of strong pressure by the general public. Monopolies were made illegal. Many combinations of big companies were forbidden by law. A number of large companies had to be broken up into smaller, completely independent units. The new law specifically forbade that these units should be linked together and

directed by any central headquarters. Price rings, trade associations, and cartels were forbidden under heavy penalties.

The new law was the despair of the American planners of that day. They regarded the doing away with the big companies as a very backward step. Doing away with the great central scientific planning, control, research and efficiency headquarters they regarded as doing away with the brain and the nerve centres of these great and outstandingly successful organisations. The new law was regarded as a set-back to the rising efficiency of American industry from which it would take years to recover. American industrial leaders said that and more in their customarily direct and forceful manner.

Profit expectations dropped, share values fell. The only argument among the experts was as to how great the set-back would be.

A couple of years later, these ideas had changed radically. The profits of most of the companies concerned had risen to well over former levels. Changes forced on American industry against its will, and in spite of its vigorous protests, had sharply improved its efficiency and increased its profit.

Americans did not need a second lesson. Other large companies, not compelled to do so by law, were split into smaller ones. If this was impracticable, or inconvenient, they were split into the autonomous operating divisions that are such a distinctive feature of American industry today.

These operating divisions are independent companies for all practical operating purposes. They are tied to headquarters mainly by policy and by the fact that their results appear in a consolidated balance sheet. Headquarters no longer attempts to plan their work for them in detail, or to make them efficient by centralised planning, and controls. In fact, it was to prevent headquarters from attempting to do so that the operating divisions were formed.

Doing away with the great central headquarters was an obvious and considerable saving. What was not expected was that the operating costs of the divisions and of the subsidiary companies should fall as soon as they were protected from these attempts to plan their work and improve their efficiency from above. No matter how efficient the man or the men at the top of these big companies, the efficiency of the smaller units rose when they were split away from them, and made to stand on their own feet, compete sharply with other similar businesses and show results.

Centralised scientific management, with elaborate staffs to plan, control, and produce efficiency went overboard. Decentralisation became the vogue. The methods of American management were radically revised to conform to these changes.

Management became as economical in the use of figures and staff in the larger and more efficient companies, as formerly it had

been extravagant. There was a great deal of simplification. Mass production had been called taking the work to the man. Now they took the planning and the order-giving to the work. These changes did not make management more difficult or less important. On the contrary, the standing and pay of American managers rose rapidly as the new methods increased the average efficiency of American industry.

Perhaps I should point out that while these subsidiary companies were merely part of a big unit, they were effectively protected from competition by having their identity merged in the larger organisation. Great planning and efficiency staffs were found to be necessary for the branches of a big company directed from the centre. There was no other way in which the efficiency of the various units could be compelled.

It was observed that as soon as the operating units were split off from the main company, and were made to show good results against other similar business which shoved them hard, their average efficiency rose. Unless there had been really sharp and effective competition in American industry, efficiency would not have risen after they had been split off. Americans believe that this sharp competition has produced much greater efficiency in operation than any of these central planning and efficiency headquarters were able to do. In that case, it was just plain common sense to do away with them and save their cost.

The American Government works on exactly the same principle. All they have ever done to keep the industries of that great country well equipped and efficient, has been to ensure that competition was sharp. It is their experience that this produces greater efficiency than would be possible in any other way. Bodies set up to plan and produce greater efficiency in industry are not favoured. Regardless of whether they were operated by the State or any other agency, Americans believe them to be wholly unnecessary, very expensive, and that they would lower efficiency more than they would raise it. That is why such bodies are forbidden by law in the United States. Here the British and American Governments differ sharply. Both cannot be right.

It is a tough picture that I have painted. It is no worse than the facts. What astounds me is your complacency as a nation in the situation in which you find yourselves today. Relative to American industry, you have been in an industrial decline that has continued in an unbroken stretch for some 65 years. The decline is not merely continuing, it is accelerating. Your production of real wealth per head is down to half American levels. It will go lower if something is not done to stop it. Nothing I have heard here or elsewhere in this country is capable of arresting that decline and starting a real recovery.

There would be some excuse if you had no other country with which to compare your industrial performances. In that case, it might be difficult to say with certainty what was possible of achievement, or how to put the wrong things right. Yet that is far from being the case. For the first half of the hundred-and-thirty-year period I have chosen to review, you led the world industrially, and in particular the United States. You coached her, you financed her, you provided her with good men and good equipment so that she could build up her industries and make them efficient. You led before—you can again.

For the second sixty-five years, however, you have sat on the toboggan and have coasted happily downhill, living on the performances of worthier men, your fathers and your grandfathers. Come off that toboggan. Show the world, and particularly your Empire, that you are made of just as good stuff as the men who made Britain great.

How to do it? My embarrassment is that the time at my disposal is so short. The first thing, obviously, is to compare your industrial performances with those of the United States and even of Canada, in order to try to find out where you went wrong. It is, I imagine, because I have spent twenty-five years in doing just that that I have been asked to address you today.

Firstly, I am not a theorist. My early industrial training was particularly thorough, and was obtained in Canada and the United States. I have managed factories and businesses on both sides of the line, years ago and recently. In this country, I have been works manager and general manager, all in different companies, and in different industries; these were for short periods only, to gain experience. I was also managing director in one of your largest businesses, but refused to consider the appointment for more than a short period. This covers my practical experience in management.

In addition, I have had experience as industrial consultant in several countries. One of my principal occupations has been measuring the efficiency of similar businesses in different countries, in order to find out where and why they differed. The measurements and the investigations would interest you, I am sure, did time permit. So also would the comparisons of working pace made in different industries and different countries. How management in this country, on the Continent and in the United States differs could not fail to interest you. The experience of American firms in Britain, and of British firms in the United States, makes as interesting a story as you could wish to hear. All these comparisons carry lessons of value to everyone in industry. These and other points of interest must wait. Let me endeavour to give you a summary of the position that lies ahead.

Management has been the weak spot in British industry for the last sixty-five years. For all that time, it has been growing steadily more elaborate and costly relative to American management. On the other side of the Atlantic, we measure the efficiency of management by the number of non-producers they require to assist them in carrying out their many and varied duties. We often express this as the number of non-producers required to manage and serve with all they require each hundred productive workers. I am simply aghast at the amount of figures and numbers of staff that a British manager requires to run a business of a given size, compared with what the American manager of a similar business would use. I wish I had time to give you some comparisons.

The effect of steady increases in the number and the rate of pay of the non-producers in British industry, relative to the productive workers, has had very serious effects. It has reduced the proportion of the population of the country doing productive work. You are painfully aware of that today. It has increased the number and the average rate of reward of those who do not produce real wealth, but merely consume it. This has compelled a steadily reducing proportion of productive workers to share with an ever-growing body of non-producers the real wealth which they actually produce. Would you like to be in their places ?

It was this steady increase in the number and the rate of reward of the non-producers in British industry that slowed up the British production of real wealth after 1880, and brought it to a halt in 1913. It is true that slower working pace and lack of enough of the most modern of equipment in industry were contributory causes. They were not the prime causes. They were the result of cutting down the reward that ought to have gone to workers and capitalists, due to expensive management.

Then came the 1914-18 war. Whenever any attempt is made to plan industry in greater detail from the top, more non-producers are always required. It was the sharp rise in the number of non-producers employed in the service of the Government, and in industry, as the result of the adoption of similar methods, that brought the production of real wealth in Great Britain in the early 1920's to well below the 1911 level. Better tools, better methods, mass production, and other changes had increased the actual output per individual worker. The rise in the number and the rate of pay of the non-producers wiped out all these gains. Productive workers, although producing more, had less to take home. The capitalists and all classes of the general public suffered in equal degree due to the same cause.

In the long period between the two great wars, organised industry in this country sought to suppress effective competition. They thought they could achieve much greater efficiency in industry by

more planning and controls from the centre. Many of the larger businesses thought the same. Scientific centralised management became the vogue. More of planning, statistics, costings and controls in individual businesses were taught as being the sure road to greater efficiency and success.

Nothing has amused me more than the quotations I have heard of Henri Fayol in this country. I had never heard of him until I came to this country. On investigation I found he was the man who is given the credit for having organised the most inefficient bureaucracy in the world, the French Civil Service. Business in this country would do well to ignore plausible speakers and writers, and to imitate only those people whose better results actually achieved in industry shows them to be safe and worthy of copying.

British production engineers did a splendid job to increase production between the two great wars. They did well considering the amount of money they were allowed to spend. There was a steady increase in the output of real wealth per productive worker. Fully half the additional real wealth produced as a result of these improvements was absorbed by the steady rise in the proportion of non-producers in many British industries. I watched and measured the steady increase in the proportion of non-producers used in many British businesses compared with similar American businesses. Had I time to go into detail, I feel sure they would be as much a shock to you as they were to me.

Then came the last great war. The number of non-producers in the service of central and local government grew with great speed. The non-producers in and charges on British businesses increased rapidly. The cumulative effect was to reduce the number of people doing productive work, and to increase the number and the pay of those with whom they were compelled to share the wealth they produced. The amount of wealth produced per productive worker rose ; the amount of real wealth he had to take home fell sharply.

As a nation you have shown the ability to face up to things when there was the need. Your fair play is proverbial—show it now. Do not turn to your slowly dwindling body of productive workers and implore them to work harder merely to enable a great and growing body of non-producers to be supported in the style which they believe to be their due. Prosperity does not lie in that direction.

If you tell a British productive worker that his output rate is only 80 per cent. of what an American worker would give under similar conditions, he is apt to give you the answer you deserve. You are getting more than you are entitled to receive. His rate of reward is only half American levels. If he knew the subject as well as I do, he would make an unkinder remark. If British Government and management were as good as they could and ought to be today, taking both words in the widest sense, the real wages of British

workers would be fully 50 per cent. higher than they are—and that without the workers working any faster.

People who live in glass houses ought not to throw stones. Those of you who represent Government or management here today have no room to criticise British workers. If all of you looked across the Atlantic, and did your job as frugally and well as similar people over there do theirs, there would be no shortage of productive workers in this country today. If you got your non-producers down to American levels, you would release enough to raise the number of people doing productive work by fully 50 per cent.

That is the only possible road to recovery. Put some of this great overload of non-producers in the service of the Government and in industry to producing real wealth, instead of merely consuming it. It would increase the volume of goods available for home consumption and for export. It would increase the reward of every productive worker by reducing the number of persons with whom he would have to share the wealth he produced. It would encourage the worker by giving him some of the additional real wealth that he has been deprived of in the past by extravagant management. As soon as they were sure of a square deal, the pace of the workers would improve.

The improved return from industry would have a very stimulating effect. Capitalists will do their full share whenever they are assured that they will receive their due proportion of any increased production of real wealth brought about by their efforts. They would then set about the much-needed renovation and re-equipment of British industry. Whenever the people of this country decide to give their workers and their capitalists a square deal, and as good an opportunity as similar people in any other country enjoy, they will reap a rich reward. Under those conditions, British workers and capitalists would make the people of this nation as wealthy as any others in the world.

The British industrial decline, relative to American, is now some 65 years old. It is going stronger than ever. It was started by weak management—management that needed too many non-producers to help it to do its work. The only way to stop that decline is to reverse the process. Put the surplus of non-producers to doing productive work.

It would be impossible for management and Government to release the number of non-producers to productive work on a scale large enough to bring about real recovery, until both learned and adopted new methods. Of those new methods, there is no sign whatever today. British management, and those who teach it, are in full cry on the old methods.

The pattern for prosperity exists. It would be a big task to put this fine old country back to where it belongs. It might take twenty years to do. What of it? That would merely mean the prosperity of all classes of the people in this country rising at double the rate Americans ever achieved over a similar period in the past. You can do it whenever you, as a nation, make up your minds that it has got to be done—and adopt those methods that alone will make it possible.

MANAGEMENT GROUP.

JOINT DISCUSSION

CHAIRMAN: Mr. L. W. FARRER, M.I.P.E.

The discussion was opened by Mr. Buckland, who asked Mr. Ord if, having given them the general impression that unproductive workers were to be deplored, and cited the American case as an object to be aimed for, he could give them a few comparative figures? He personally had spent some years in the States, and had been struck by the fact that the bigger American companies did favour having rather large general planning staffs which they used to send to their outlying factories. In the firm with which he was concerned, that department was a considerable liability, but it insisted on earning its "corn".

MR. ORD said it was very difficult to give figures. Some of the worst cases of extravagant management he had seen in the United States. Americans were not perfect, far from it. Yet the American production of real wealth per head of the population was about double that of the British. Slow working pace accounted at the most for twenty per cent. of the British deficiency, although he was inclined to think it was not quite as high as that.

What accounted for the remainder? Lack of enough modern tools and equipment was responsible for nearly thirty per cent. Lack of a sufficiently large proportion of the total British population doing actual productive work was the principal cause of the low British production of real wealth compared with America.

Too much was made of the lack of volume in this country. Canada had only a quarter of the British population, and added handicaps of great distances, cold climate, and lack of coal. The speaker did not think that the average Canadian industrial handicap due to lack of volume reduced her industrial efficiency from more than five to seven per cent. At Canadian levels of industrial efficiency, Great Britain would lead the United States in the production of real wealth per head.

The real cause of the drop in production was that too many non-producers were carried on the backs of too few productive workers.

MR. DUMBELL said he had seen American production, and he thought they had something which we had not. Primarily he thought they had larger quantities, and that gave them a decided advantage. He had the impression that industries comparable in size with ours were not more efficient, but that other industries with much larger quantities were decidedly more efficient.

If we could give the men in this country sufficient material, they would naturally go at it, especially if the remuneration did not come too easily. The suggestion that the matter would be remedied by increased remuneration was not the answer. At the moment the country was suffering from a terrific shortage of every type of material, and we were up against this obstacle all the time.

MR. ORD thought that question went back to the production of material. The advantage of volume was less than had been assumed. Take an average British mass production factory and transfer it to the United States or Canada, complete with staff, workers and equipment, and much higher output rates would be obtained in practically every case as soon as the staff and workpeople had become acclimatised, and had adopted the industrial teachings of the new world.

There were no better production engineers in the world than the British. Yet give them all the money for tools that they wanted, they still could not get American output rates until they had learned to handle British workers as well in this country as they are handled in the United States. It was not wholly a matter of leadership, however. What they took home in their pay packets had a lot to do with it.

MR. PUCKEY thought it might be of interest if he gave the impressions of a team of people he had taken to the States recently. They spent quite a long time studying American industry, going into it in detail, and finally produced a series of observations which in their view gave a precise indication of the relative improvement in results over there as compared with ourselves here.

They believed that in the States and Canada a considerable measure of success was achieved by the expediency of response of the workers to all decisions by all grades; there appeared to be a greater tendency for all branches of the business to be less complex and by direct action to achieve greater results; behind that all individuals, regardless of the department in which they served, showed a greater acceptance of a timed stage control of manufacture; industrial records kept were few and compressed, and discontinued largely when the specific purpose was fulfilled; controls and systems were reduced to bare necessity, which resulted in a simplification of office control; the personnel of American factories generally had an enterprising and alert attitude of mind, which resulted in more intelligent and effective work than the average met with in this country.

He agreed very largely with them. There was very little direct reference to production in their report; they were engineers and they did not come back and say that obviously the Americans were necessarily better production engineers than we were. Probably the whole thing boiled down to management—the attitude of

management in all grades to the job, and he thought that therein lay the secret of their greater success over ourselves.

He stressed what he had stressed earlier in the discussion—the question of managers surrounding themselves with paper work and with non-productives. He regarded it as the greatest weakness of this country today, and they as managers must be blamed for it.

MR. GAROTTI said he entirely agreed that emphasis was undoubtedly on the increase, during the war years, of non-productives. But to be constructive, what departments should they tackle and reorganise? What did they look at, and what sort of practices did they break down into detail and try to do something about?

A previous speaker had stated that we were very short of raw materials. What could we do about them to ensure a greater flow, so that we could get better production?

MR. PUCKEY thought if he had a job of reorganising to do, he would get down to some system of measuring what he wanted, and try to define it. In management one of the things lacking was a better system of measurement. They wanted something better, but they did not know how much better they wanted it. One of the finest ways that we in this country could improve our efficiency was to make comparisons with other people. We had the tremendous advantage in that respect, in that we would be walking along a path pioneered by those in front of us. There were many things in America and Canada which he did not like, but there were other things which were good and we could set our standards by theirs.

A practical way for us to improve our businesses was to make comparisons between our own business and others in the same line, and of a similar size. In one case in recent months, comparisons were made between three firms, one in America, one in Canada, and one here. They were making similar products and turning out a comparable volume of goods. Non-productives were just under 60 per cent. of productives in this country, 31 per cent. in the United States, and 38 per cent. in Canada. There a direct comparison was made first, and as a result 56 people had been removed from non-productive jobs in the plant in this country. There was a direct comparison for the management to act on, and he thought we should do more of it.

He would like to see more managers going to countries where pioneering work was being done, and taking advantage of it.

MR. MAINE thought the discussion on overheads useful. There were three points which contributed to the higher overheads which we had to carry.

Speaking for the electrical industry, there was the complexity of the product we made. We had many demands from all kinds of customers, particularly from home customers, which from a

broad point of view were unreasonable. That problem could be tackled by educating the buyers and the designers.

Next there was the large number of controls which operated at the present time. Unquestionably management was carrying out a large proportion of the work the Civil Service should be doing. Then there was the question of materials, and there difficulties were very great. With the need for setting targets, emphasised by Mr. Puckey, he was in full agreement. It had been his policy, and that of his firms, to set targets as soon as they could, but today conditions changed; conditions could not be regulated even at national levels, so that now the setting of targets became very difficult. But the problem of maintaining materials, and dealing with the controls involved, was one which concerned them all.

MR. ORD thought the talk was wandering off the subject. The troubles they were there to discuss were production problems, and management as a means of increasing production. They were not producing enough in this country to pay for their imports, or to give the people a fair standard of life. There were three principal reasons—men were not working fast enough; they were not well equipped; and there were not enough of them doing productive work.

This might seem over-simplification, yet it was the key to the problem. The subsequent speakers missed one point. Mr. Puckey quoted Canada. They were comparing this country with a country which had one quarter of their population. Any figure obtainable in Canada ought easily to be bettered here. If British businesses, size for size, were as efficient as Canadian, they would beat the United States. Canadian industrial efficiency was not more than ten per cent. lower than American.

A big country was a handicap. Three-quarters of the population of Canada lived in a strip little more than a hundred miles wide, but more than three thousand miles long against the Northern border of the United States. They had more miles of railway main line than we had in this country, with a population no larger than that of Greater London to pay for it. From the place where it was mined to the place where it was burned, each ton of coal in Canada had to travel more than ten times the distance it did here.

Americans had to move most of their high grade iron ore from the Mesaba Range, south-west of Lake Superior, by rail to all their various steel centres. This country could bring iron ore by sea from Spain, Morocco, Sweden, or Newfoundland, and lay it down at a fraction of what it cost the Americans to move their iron ore by rail. Britain had the great advantages of compact population, good harbours, mild climate, and excellent seaborne communications.

It also had the advantage that the people were of one common orderly race. The people of this country did not realize the great industrial benefits they held over any other, and full advantage should be taken of them.

American and Canadian trade unions were founded by the British unions. For a time, the policies of the unions on both sides of the Atlantic were the same. Now unions and Governments differ widely in their industrial policies, and these differences do affect the efficiency of industry in the respective countries.

During the war, the British Government had built what amounted to a completely new aircraft industry. British aircraft expansion started ahead of the American, and was carried through almost regardless of expense. In 1942, a member of the American War Production Board, on a visit to this country to inspect British aircraft factories, broadcast over the B.B.C. before he returned. He stated that the British man-hours per pound to build military aircraft was double the American figure. The American lead is greater today.

This did not have to happen. Had the British Government acted wisely, there was no reason why this country should not have secured the same sort of lead in aircraft construction that they had always held in shipbuilding.

The CHAIRMAN said there was one question he would like to ask : How much capital was employed in similar industries, having a similar volume in the United States and here, per employee—capital in building, plant and equipment ?

He had some figures provided by the National Association of Manufacturers in America, which he believed were accurate. Capital investment in property, plant and equipment for the Ford Company—9,000 ; for the American Rolling Mill Corporation—14,000 ; for Electrical Utilities—47,000 ; and for the Railways—26,000. He suggested that those figures were much higher than for this country.

MR. ORD said the Chairman had asked an awkward question, and one that was difficult to answer briefly. The capital cost of the L.M.S. Railway was more than five times as high per mile as that of the Canadian Pacific. There were many other industries in this country with a capital investment much higher than in the United States for the output rate achieved. Many British companies spent much more for land and buildings than similar companies in the United States. Our stock and work in progress were often very much higher than American for the output rate achieved. These things all affected capital investment.

In the States they would take much of the money that the British tied up in buildings and stock, and put it into machines. We were short of machine tools and used less power than was necessary

to achieve really high efficiency. Moreover, we persisted in doing, by batch production, work which ought to be done on mass production lines.

The very high figures they had to pay for real estate, however, tended to inflate American capital investment costs. In the country of wide open spaces, land often cost three or more times what it did here. In addition, there were American factories where the land needed for the parking of workmen's motor cars was almost as great as the area on which the factory stood.

MR. PUCKEY thought the problem was not so much the nominal capital employed in the business as what they did with it. His experience was that generally production engineers did not put the heat on enough when it came to making money available for new equipment. Managers in this country did not appreciate as fully as they might the necessity for devoting more adequate resources to the buying of new machinery, and depreciating existing machines at a greater rate.

Some months ago he had joined the Hosiery Working Party and had learned several things. Although he had grumbled about much of the engineering plant in this country, he had seen nothing to compare with what he found in the textile mills. He had been shown looms by the hundred, and had been told that they had been bought at the turn of the century at a cost of £5 each ! The book value was as low as it was possible to put it. There was no wonder the cotton industry was in the condition it was today.

Capital employed was not a serious thing if the money was used in a right way. Certainly production engineers ought to press very much harder for money for first class productive plant. He was certain that managers would have to make that money available. But with it all, money today did not matter ; there was more money in this country that we knew what to do with. The *productivity* of the people was the important thing. Our problem was managerial and not financial.

MR. ORD said he had refused to go on a Working Party, and had told those who asked him what the Working Party's report would be. The Working Party Reports would put this country further into the mess, instead of helping it to get out. The Working Party Report on Potteries, for example, ignored slow working pace as completely as if it did not exist. Why ?

The Working Parties recommended improvements in the tools, equipment, and productive methods of the industries concerned. These recommendations were good. The production engineers of the industry, and not the Working Parties who got the credit for it, supplied that information.

All the Working Parties Reports that he had seen recommended heavy increases in the figures to be used in individual businesses.

They recommended heavy increases in the number and in the rate of pay of the persons who performed the many and varied functions of management. They recommended an increase in the proportion of non-producers in British industry, already too high.

In the United States, it would be regarded as a joke if some politician, twenty-four hours after he was appointed a minister, called the leaders of some industry together and gave them instructions as to how to make their industries more efficient. Their recommendations were piling up the number of non-producers in the service of the Government and in industry. This was why the country was short of people to do the productive work. They were loading more non-producers on the backs of the productive workers, and ended up by saying: "Now, boys, go on and work harder and save the country—sorry we cannot pay you any more".

MR. HILLSOM said there had been a great deal of emphasis laid on the problem of overheads. He was well aware that the conference was on national productivity. Surely there were one or two points which meant more than overheads? One was a consideration of the optimum size of production unit. It had been touched upon, but not sufficiently. Surely they did need research somewhere to show where that field lay, where the optimum production unit was, and what it was going to be for any particular range. He would like to know how to achieve that.

He knew that in the States they had the attacks of the larger firms by competition, but what of the straight consideration of the number of firms we needed, of such and such a size to produce our consumer demands in any given product range? Why should we have to leave it to cut-throat competition? Why should we have a condition of affairs which existed in the States in 1938 when about 80 or 90 per cent. of all new firms failed in two or three years? That was a sheer waste of brain and capital, probably because they were pushed out by larger concerns.

Then there was the training of the future managerial team, to which greater attention must be paid here. At the moment, one could get a managerial position far more easily by influence than by ability, which was all wrong. It was time the manager was treated in the same way as the architect or the engineer. They demanded of them a practical background, and to ask for the one without the other was a bad thing to do. It would either produce a nation of hard-headed practical men, or it would give us a nation of theorists with their heads in the clouds and far away from practical plans.

MR. ORD said that industry here seemed always to attack the workers, and to demand that they produced more, and more cheaply. British management, on the other hand, was asking that the allowance for management, already too high by American standards,

should be further increased. It was in order to pay for this increase both in the cost of government and in the cost of management that the productive workers of this country were being asked to work harder. That was not fair, and British management was largely to blame for this situation.

There was too much talk about management in this country. In an average American factory, the foreman did most of the supervisory work. Management attempted to do far too much here, and did not delegate authority to the degree that it ought to do. The best way of judging the quality of management in any factory was to assess the average quality of the foreman. Selecting and training these men was the principal duty of the management. How good the foremen were was, therefore, one of the best tests of a manager's capacity.

There was far too much praise of management in this country and far too little mention of the foremen, who should be an even larger factor in all supervisory work. Foremen in this country were given less opportunity, responsibility, and praise than was their due.

MR. PUCKEY, speaking on the optimum size of a unit, said he agreed it was very depressing to see a large number of smaller firms go " phut ", just like that. But he thought it would be even more depressing trying to avoid letting those people " have a go " at it. It was essential that any individual should " have a go ", if he was enthusiastic enough and was willing to take the risk. One of the criticisms he heard more frequently today was that there were far too many restrictions to conform to, and by the time they had all been met, there was not time or enthusiasm left to deal with building the business. Anyone should be given the opportunity to build up a business, providing he satisfied certain basic legal requirements.

As to the optimum size of a business, it was very difficult to give a satisfactory answer. He had seen what appeared to be effective factories of 40,000 or 50,000 operating in one group, and he had seen smaller factories in which the manager and two or three men were working together and doing a happy and efficient job.

His own experience had convinced him that, if anything, one ought to plan for something smaller rather than for something bigger. If they were to be bigger, they should try to break the job down, and decentralise. If they were expanding, they should try the experiment of setting up smaller groups somewhere else; try expanding the managers a bit and making the people responsible in some remote area for obtaining their results. If they did it that way, he thought they would instil greater enthusiasm among the people. He thought we were getting too much centralisation and

control in this country. We had, he believed, many large corporations who, if they only realized the amount of frustration and indifference that existed on the outskirts, would do more about it. The optimum was not a matter of defining how many people one could place, but how local enthusiasm could be created without destroying efficiency.

In light engineering, for example, if one worked on an optimum size of about a thousand people, one would probably find it was a very satisfactory unit, and one in which the men at the top knew by name all the charge-hands down below. When they got to the stage where top management did not know the names of the junior manager, it was time to break down a bit.

On the point of training managers, there was the British Institute of Management, sponsored by the Government, but he did not know if they would do any good or not. He regarded the foremen as a part of the management. Management was something for which considerable training was needed, and he rather agreed that in the past it was more a matter of influence than ability. Today, they were finding more people who were going into the job of management through the ranks than was the case in the past.

He knew of many examples in America today where they were falling into the same trap that we fell into, in which influence overshadowed talent. In this country we were tending to strengthen management by accepting more fully the view that people with ambition and energy would ultimately find themselves in top management. If such people felt that nothing would stop them getting on by their own judgment and personality, energy, or will, nothing would stop them, even if they had no influence.

The CHAIRMAN announced that as their time had been exceeded, he was forced to close the meeting, and called on Mr. Tomlinson to propose a vote of thanks to Mr. Ord and Mr. Puckey.

A spontaneous and informal vote of thanks to the Chairman concluded the session.

PLANT AND EQUIPMENT GROUP.

"PLANT ECONOMICS"

By E. W. HANCOCK, M.B.E., M.I.P.E., F.R.S.A., F.I.I.A.

CHAIRMAN: Mr. B. NEWBOLD, M.I.P.E.
(President, Coventry Section)

(Mr. Hancock is Works General Manager of Messrs. Rubery Owen and Co. Ltd. Before joining this Company he held various executive positions with firms in the motor industry. He is a Vice-President of the Institution, Past Chairman of Council, and Past President of the Coventry and Wolverhampton Sections).

The subject of this paper allows a variety of treatments from the purely financial to the more practical aspects.

It is my intention to strike a half-way position, giving as wide a review as possible, so that the attention of all engaged in Industry may be directed towards the part they can play in helping to establish and maintain a high standard of efficiency.

This is a vital matter in the national interest, not only today, but to satisfy the future desire of civilised peoples wishing to live in a land of peace and plenty.

What is Meant by " Plant Economics " ?

Taken in its widest sense, it means that modern industrial undertakings should be equipped with plant, modern in conception, in a fit condition to earn profits regularly, pay good wages, and produce a yield per square foot per hour on an internationally competitive basis, both for price and quality.

Plant covers a very wide field, as apart from direct production plant, service plant must also be reviewed, such as heating, lighting, power, ventilation, material handling, etc., and all the wide range of services which make factory life not only efficient in operation, but having conditions under which human beings can work happily and with inspiration.

Plant should be employed for a specific economic purpose ; in other words, plant and machinery are the modern servants of Industry and these new servants must be worthy of their hire.

Whilst the brains of industry are provided by human beings, the " heart " is the plant and machinery in that industry, and unless the " heart " beats regularly, then the body dies.

The first important study, therefore, is Maintenance and Repair of Plant.

Maintenance and Repair.

The word " study " is used because the subject *is* a study, and not to be treated lightly or as an afterthought.

If the chief economic factor is the efficient use of floor space, then every item of plant using floor space must be put to efficient use. Regardless of the antiquity of the plant, it is vital that it must be maintained in the best possible condition. Because plant is old, it should not be left to " die on its feet ", and remain a " husk ", to absorb valuable space, heat, light, etc.

Much has been written on this subject, but the point to be stressed is the question of Preventive Maintenance. It is an expensive policy to wait until something goes wrong before attention is given. " A stitch in time saves nine " is in the long run the cheapest, and not only does it save maintenance and time, but keeps the plant running more efficiently for a longer period.

By keeping accurate Plant Records and regularly carrying out a routine inspection covering cleaning, lubrication, minor repairs and adjustments, many of the major breakdowns can be avoided, particularly with electrical equipment, motors, etc.

Should a major breakdown occur by some action of misfortune, or misjudgement, putting the plant out of commission for a period of say one week, then not only should the cause of the breakdown be repaired, but the opportunity should be taken to check over the whole machine, and carry out any other repairs of a minor or major character within the time required for the first major repair.

This same opportunity should be taken to clean down and re-paint the machine, so that when it is returned to production, it will help to establish the correct standard of good housekeeping which should be set in a modern industry.

The economics of adopting this policy can easily be checked and proved, as costs involved in stripping down for a major repair need not be duplicated at a later date, if full opportunity is taken during the initial stripping down, to deal with other minor repairs.

Some very interesting information is found by plotting periods of breakdown (particularly on key machines) to see how many periods of breakdown could have been saved by taking full advantage of the first major breakdown.

It is a matter of considerable importance that operators using plant and equipment of any description should be trained to understand the necessity of maintaining and caring for the plant and equipment which they operate. Apart from any other consideration, this plant and equipment represents their means of livelihood, and should be cared for and cleaned as a matter of conscientious habit, rather than as a result of disciplinary action.

Calling the attention of the foreman and Maintenance Department to any slight defect is the first step towards preventive maintenance. Operators can, with their detailed knowledge of the plant which they are operating, quite frequently locate the first signs of a breakdown, and they should be trained to understand that they have a responsibility in playing their part, both in their own and in the national interest, in the care and maintenance of plant and equipment.

A conscientious approach to this question by the operators can do much to help this important question, particularly with juveniles and newcomers.

Replacement Policy and Programme.

The two chief reasons for replacing plant are:

1. Obsolescence, due to age and condition.
2. Obsolescence, due to design and method.

When approaching this question, it should always be kept in mind that the plant in a factory is only a means to an end, that end or aim being the economics based on the description given at the beginning of this paper.

1. **Obsolescence due to Age and Condition.**

It is fair to assume that as the capital cost depreciates and falls, so conversely does the maintenance cost rise. Assuming that plant is kept efficiently at work and maintained up to a correct standard, it is fair to assume that there will be an economic period of the plant's life, after which the cost per annum will rise above an economic level.

There will be a time when the maintenance cost equals the written down cost of the plant, and it is at this point and onwards where a periodic study is necessary as to whether the economics justify consideration of replacement.

When the maintenance cost has reached four to five times the capital cost, the plant has probably passed its economic life and thence onwards becomes an additional burden of expense and unreliability.

Loss of output due to repair periods must also be included in this study.

No general rule of time can be applied for all plant, but targets should be set against groups of plant for this investigation.

On Production Plant the period of time for replacement may vary from five to eight years, dependent upon the type of plant under consideration, and the extent to which it is used.

It is often more economic to run certain expensive plant day and night, in which case the period of obsolescence (in Calendar Periods) becomes shorter, but so long as the main factors of plant obsolescence are appreciated and a check made relating the written down cost of the plant to the maintenance cost, then the same principles will apply.

It will be clear that the greater number of hours used per annum will, in turn, increase the maintenance cost per annum. Reference to the chart will indicate the broad principles to be applied. (See Fig. 1, General Plant and Machinery.)

It is false economy to try to avoid proper and thorough maintenance work, as the economic losses will grow out of proportion to the life of the machine, and will probably lead to a major breakdown requiring a major replacement, or repair, which is much more

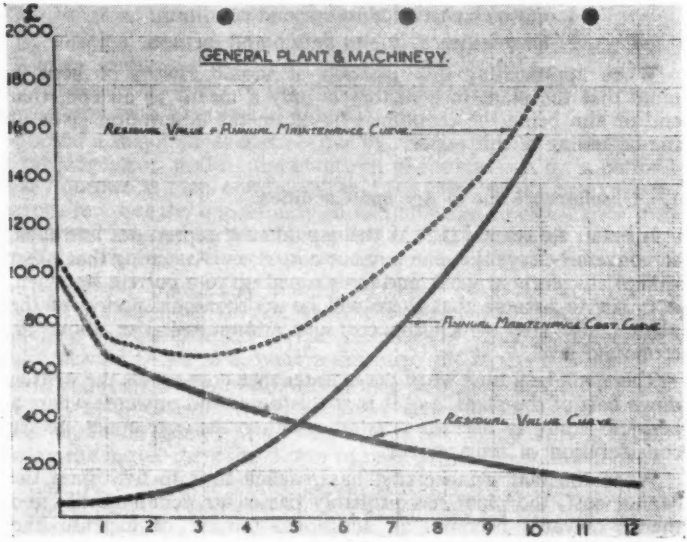

FIG. 1.

costly taking all factors into consideration, than regular maintenance. Always include the loss of output in calculations, including consequential losses.

On this point, it should be taken as a good policy " To put back into the plant what has been taken out of it ", just in the same way as a good farmer does with his land. The most fruitful soil is that

which has been well-maintained and cared for, and this goes for plant as well.

Believing it to be an important part of good Works Management, there should always be before the Directors at least an annual review and a clear and frank statement as to the condition of the Company's plant with the suggested overhaul and replacement programme clearly stated, covering twelve months at least.

With such a forward programme sanctioned early, time is allowed to all concerned to pre-plan for this work of overhaul and replacement, thus allowing the Plant Engineer to study the best and most up-to-date replacements.

2. Obsolescence due to Design and Method.

This question is one of the greatest importance in this machine age, as the ingenious brain of the Engineer is for ever seeking more economic methods of production in order to be nationally and internationally competitive.

One simple example of this is in the machining of stampings, or castings, whereby the Machine Tool Designer has developed more robust machines, higher cutting speeds, etc., thus increasing the amount of metal removed per hour.

Whilst this development has been made, other developments of a more scientific use of original materials have also been made, whereby stampings and castings are produced to very fine limits requiring little or no machining of the heavy type, a finish grinding operation only being necessary.

The closer the difference in weight between the " Raw " material and the finished article is becoming more important. Examples of this are Cold Heading, or the Hot Coining Process, on stampings ; and Powder Metallurgy, or Waste Wax methods of producing castings ; or half pressings flash-welded to replace either castings or stampings.

These processes would immediately render obsolete heavy swarf-creating plant to be replaced by finish grinding plant, etc.

I believe that machine tools smothered with swarf being removed at " blank " cubic inches per minute is becoming the modern sign of inefficiency. Also, on individual machines, the automatic machine is replacing the hand-operated machines ; new methods of all kinds are being introduced, which demand a very careful study to ascertain when one's plant and methods are becoming obsolete.

This is all a question of overall economics, as to whether basic methods should be changed affecting expenditure on new and different plant. Certain very special purpose machines are " written off " at increased rates, depending on the duration of a particular

project, but this is not done arbitrarily, but is based on the economics of using Special Purpose Plant as against Universal Plant.

If the saving of costs, floor space, etc., based on a certain minimum production quantity shows an overall economy, then there is every reason to give this type of special plant full consideration. (See Fig. 2. Special Welding Plant.)

Alternatively, if Universal Plant is used and batch production planned, whilst the plant itself may be employed more regularly, batch production does involve increased capital invested in partly

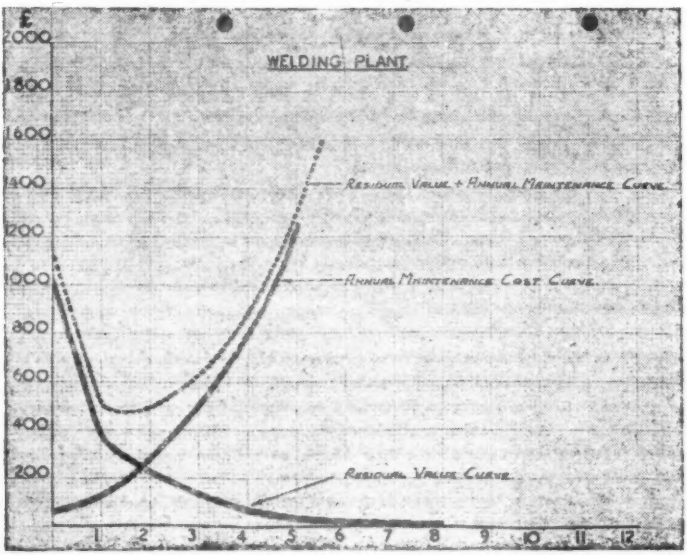

FIG. 2.

finished goods, and has to be taken into account when comparing the economics of the " FLOW " method of production, as against the " BATCH " method of production.

We in this country need to make a very much closer study of this whole question of plant replacement, and it is interesting to read certain observations made in the Working Parties' Reports indicating that certain basic plant is obsolete.

Now the cause of this is not all one-sided, as many attempts have been made in this country to bring basic plant up to date, but it is not in every case being used to its full capacity by labour ;

the fear of unemployment is probably one of the chief reasons, and yet there is much to be done to educate all classes on this question of modernising our basic plant and using it to the fullest and most economic rate.

No purpose whatsoever is served by Management calculating the economics of installing new and more productive plant, unless labour is willing and keen to use this plant to its maximum efficiency. We in this country must pay more attention to "Jobs per hour", than "Price per Job", if we are going to equip our workshops to stand at least equal to our international competitors.

If labour wants a higher standard of living, increased wages, and shorter working hours, it must in return see that modern machines are made welcome in the factories, not because they are "easier to work", but because they can turn out "more and better jobs per hour".

This question has been stressed as it is a vital factor in the development of this country's industrial life. We are all in it together, and therefore let us remember the age-old advice given by Marcus Aurelius, "That which advantages not the hive, advantages not the bee".

We must all encourage the use of the "New Servant", machinery, if we ourselves wish to rise above our old general standards, and by so doing shall we encourage the brains of the engineer to devise new and more productive machines for our use.

This question of the return of invested capital in new plant is a study which has to be made in any case, if appropriate replacement plant is to be purchased, and replacement plant is either purchased as dictated by the maintenance cost of existing plant, previously referred to, or is purchased based on increased savings and productivity over the plant to be replaced.

This study should be made not only on production plant, but also on the main services, heating, lighting, material handling, etc., as an investment in plant of this type can often pay for itself in three to five years. That which appears to be a sound investment, on casual investigation quite frequently proves to be not worth while, when studying all economic factors concerned.

A balance has to be struck between money invested in specialised plant and equipment for "Flow" production, having on average a greater number of plant idle hours (due to unbalance); or money invested in production material produced in batches on Universal Plant, having on average a greater quantity of idle production material in process. Money invested must be studied not only on plant, but on production material and stocks of partly and completely processed material. This is a very wide subject, and can only be briefly referred to.

Should Plant be Built to Last ?

There is another question frequently raised in connection with plant, namely " Should plant be built to last, or with a view to replacement in a few years ? "

It is felt that neither of these two considerations should be in the designer's mind in the first place, as the first consideration must be for efficient production both for quality and quantity. This being so, it is usual to find a tendency towards robustness, both in general construction and in the size of bearings, gears, etc., in order to give accuracy free from vibration, so as to remove metal in the shortest time to give the required standard of finish.

These considerations are inclined to result in plant having a long, accurate life, and provided this plant achieves the economic end, then its replacement is covered by the two main considerations previously referred to.

Best Efficiency from Existing Plant.

All the above has reference to certain assumptions of good standards, but for various reasons there still remains in many cases the practical daily problem of using " the tools that lie under our hand ", namely, to obtain the best efficiency from existing plant, whatever its age, against the time when new plant can be installed.

Here again, it must be repeated that whatever the age of the plant it should be kept always in a good state of repair, but despite this there are today more exacting requirements from machines leading to the evolution from " Fitting " to " Assembly ". Not so many years ago the machine shop semi-finished machined, leaving a considerable amount of individual hand-fitting of piece to piece to be undertaken by the fitter, whereas today, with greater demands for mechanical efficiency and interchangeability of parts, little is left to the " fitting " process and only " assembly " is called for, and in some exacting cases " selective assembly " is used.

If this demand has to be met with old plant basically incapable of working to fine limits, then the required accuracy in many cases can still be obtained through the medium of special tools and fixtures, using the machine as a driving and feeding medium only. Self-contained boring fixtures with universal joints on the boring bars can still produce to accurate limits on old machines, but this, in turn, increases the investment of money in jigs, tools, and fixtures.

Multiple operations carried out on modern plant can be split up and successfully carried out on old plant, and whilst in many cases the required degree of accuracy can be obtained, the operations are usually slower and more floor space has to be absorbed for a given output.

These losses must never be lost sight of from the economic point of view, as enthusiasm too far towards adapting old plant by special fixtures can sometimes lead to a false economy, and therefore the overriding economy must be continually assessed in order to strike the correct balance.

Standards of accuracy and finish now being regularly built into new machine tools were not measurable twenty years ago, as the advancement of measuring instruments of all kinds has made such rapid strides that a ten-thousandth part of an inch is so amplified as to be easily read by unskilled inspectors.

This question of measurement and measuring instruments is a study in itself, and well worth a study, if we are fully to realise the progress that has been made in Production Engineering.

The regular measurement in micro-inches for surface finish alone is but one indication of the progress made; consequently, if the finished product has to be subjected to these searching inspection instruments, then the " Means " of production must be equal to the " End " under inspection.

This point is stressed, as it is so vital to this question of Plant Economics if " Assembly " is to replace " Fitting ", as skilled hand-work must be reserved for the Toolroom and Machine Tool Production, etc., where today, due to the influence of the Production Engineer, more than ever is there an increasing demand for skilled craftsmen, allowing the basic tool, or plant, to reproduce economically the production accuracy required.

Best Use of Plant not Ideally Suitable.

Again, quite frequently due to the variety of products that we have to produce in our factories in this country, it is not always possible to use just the correct and exactly appropriate machines. Here it is important to have available " Standard Costs ", as a guide as to how far costs vary from a good standard.

In any modern factory there should always be available ready for reference a set of " Best Standards ", either in output per square foot per day, or turnover per square foot per day, which would include costs of heat, light and power consumed per production unit. All these standards should be set to the best known efficiency so that an overriding check and control can be quickly applied.

It is not necessarily an economy to put a youth on to an unsuitable machine at a lower piecework price if the output per hour per square foot is seriously below an agreed standard, as unless a check is made embracing overall costs against a standard cost, one may be misled to assuming a saving which may in fact be a loss.

Quite frequently, however, by again studying the overall cost

position, it may even be an economy to clear a bottleneck in production by undertaking certain operations on unsuitable machines if, by so doing, this releases a large assembly for sale.

Working from standards it is possible to set maximum limits, within which there lies a reasonable economic result, even though the plant is not entirely suitable. If, however, the costs are outside the maximum standards, then either the policy was wrong in the first place in undertaking unsuitable work for the plant, or a replacement of the plant is necessary.

This latter point should be dealt with before hand by pre-planning new projects into the Works, so that the replacement of plant is anticipated in good time, and not left to the last minute for emergency action.

Much of this subject and its treatment depends upon the type of business concerned, as small outputs of large assemblies will require different detail treatment than is the case with large outputs of smaller assemblies planned on " Flow " production lines. Nevertheless, standards of efficiency can be applied to any type of business and need not necessarily involve a heavy burden of staff work.

Such statements as " I remember the time when we used to turn out 10 a month, but now can only turn out 6 per month " is showing in an arbitrary way that there was a previous standard which has dropped.

This position is not unknown today, and needs immediate investigation as to the cause, as good management should know the correct economic standards and should give a clear picture to the directors of that business, indicating what needs to be done to maintain a correct standard of production efficiency.

A factory is only as good as the men working in it ; by this I mean all from the managing director to the apprentice, and the production from that factory is the undeniable evidence of the standard of efficiency, which must not be checked against just one year's working, but against a continual run.

All factories should be planned on a permanent basis, and not for a short-term money-making period. Consequently, long-term and sound policies will direct attention to the vital importance of Plant Economics, which is one of the important " means to an end ", that end being to establish a standard of efficiency and a standard of good housekeeping which, whilst making a factory happy and pleasant to work in, having good standards of wages, is able to compete nationally and internationally both for price and quality.

Plant Economics are not just the business of the Works Accountant, although his advice and guidance should always be taken into consideration, but is part of a much wider whole, which will keep

the workshops of this country in a fit and proper condition to withstand competent competition.

This country has continually demonstrated to the world its ability to hold a premier position with its development of designs and specifications. It is still for this country to establish its ability to reach a volume of production at a price which will allow it to hold its right position in the markets of the world.

This is the subject which must interest everyone in industry, whatever their status, as there are very few "geese" left laying "golden eggs", and the future of the industry will depend entirely upon its own ability to assimilate and apply more scientific methods for its own economic development.

It is important, therefore, for all interested in industry to appreciate the importance of the broader aspects of Plant Economics, and the real influence that this question has upon industrial efficiency.

This is a subject which all in industry should study, thereby giving universal contribution towards a time of peace and plenty. This subject, in common with many other relevant subjects, must be tackled in a competent and fearless manner, if the industrial life of this country is to hold its rightful position in world affairs.

PLANT AND EQUIPMENT GROUP.

"THE UTILISATION OF PLANT"

By J. E. MACLAREN, M.I.P.E.

CHAIRMAN: Mr. H. BAINBRIDGE, M.I.P.E.

(Mr. MacLaren, who is Managing Director of Messrs. B.S.A. Tools, Ltd., was trained with Messrs. Brown and Sharpe, and subsequently spent 27 years in the British machine tool industry. During the war he was Chairman of Machine Tool Control and later Midland Regional Controller, Ministry of Supply. Before taking up his present appointment, he was Deputy Chief of Economics Division, German Control Commission).

Never in the history of this country will the time be more opportune for a free and frank discussion of the problems which beset production, and it appears to me that the only salvation for this country lies in her ability to increase production more and more if we are to combat successfully the vicious spiral of prices and wages and thus avoid inflation. The Government are now alive to this urgent need, as is evidenced by the following excerpts from the White Papers presented by the Minister of Labour and National Service to Parliament. They give no constructive suggestions as to how this aim can be attained but have left it to industry to extricate itself and the country at large from the dire straits in which they find themselves.

"Increased output therefore is the thing that is needed more than anything else for all these reasons:—

(*a*) to achieve the job of carrying out the enormous programme of work that is waiting to be done.

(*b*) to increase our exports in order to pay for the imports we need.

(*c*) to increase the quantity of goods for home consumption so that inflation can be avoided and a real improvement in the standard of living secured.

"We must remove the idea of spinning out production in order to avoid unemployment, or of restricting output in order to safeguard earnings. On the contrary, industry—employers and workers alike—must be ready to adopt every possible means of increasing production in the secure knowledge that this does not carry with it any threat to employment. In fact what is wanted is a new determination to achieve a high and stable level of employment and increased production. Indeed, without high production, full employment itself is endangered". A further White Paper "Economic Survey for 1947" stated in even bolder language the true state of affairs in our country and leaves it to those concerned,

industry, labour and others, to face up to the fact and work out ways for attaining the aim.

Now therefore let us examine the position in our own particular sphere, the Engineering Industry. A lot is said in both these papers about increased production being so necessary and although it is implied it is never specifically mentioned, that UTILISATION OF PLANT is one of the real keys to the solution.

There are various interpretations as to what is meant by Utilisation of plant and any one of those interpretations would cover a very wide field. I do not propose in this short talk to bother you with a lot of statistics and comparisons which too often are only odious, but I propose to talk on what has been and has *not* been done in the past to see that plant is properly utilised, what we are doing now and what can be done in the future.

1. **Idle Machine Time.**

During the war the plant as a whole was of very high order, many plants, including Shadow Factories, being equipped with machinery, tools and equipment of all kinds that were in every way the last word. As the war progressed, our home production of the necessary equipment increased and for a time imports, especially from U.S.A. of high class machine tools, small tools etc. increased, with the result that until the bombing upset our plans somewhat, our plants generally were equipped with the very best that money could buy and even then we were not getting a proper utilisation of plant.

A Rationalisation Scheme was introduced by the Machine Tool Control which endeavoured to see that each manufacturer produced the type of machines he could best make to fit in with the war programme and that as much standardisation and simplicity as possible were secured. Bearing in mind the immense variety of types and the complications of the industry, and considering the scarcity of really skilled engineers for war-time programmes after the Armed Forces had taken their quota, the question of utilising the machines and plant became a very serious one indeed. Earnest and quite successful means of getting better utilisation were employed. One needs only to quote the Emergency Machine Tool Armament Corps (E.M.T.A.C.) a body of men recruited from industry, highly skilled in the use of all types of machine tools, who from the Summer of 1941 did a grand job of work. Any firm on work of national importance requiring assistance was able to call on EMTAC until their difficulties were ironed out.

There was also an organisation to ensure that after a blitz, machine tools and plant were got back into working order again as quickly as possible and that damaged machines were repaired and made ready for use again.

Another achievement in the drive for more production and the better utilisation of plant was brought about early in the war by the inauguration of the Mutual Aid Scheme, which came into being in connection with the nation-wide survey of cutting tools instituted by the C.G.M.T. and carried out by men lent to the trade. Following a proposal and trial in the Midland Region of a Voluntary Survey Organisation, carried out by members of the trade, a number of Mutual Aid Exchanges were set up and firms were invited to attend meetings held in different districts of the Region and to present to these meetings details of their immediate and most urgent shortages, at the same time giving details of tools and equipment which they were prepared to lend or sell to any firm who might be in urgent need of them. These meetings were presided over by a Chairman who called on each member in turn, and something like 80 per cent. of the demands put forward were satisfied then and there. The two parties to the transfer were put into direct contact and apart from a note of the transaction no official paper work was involved. The scheme was an immediate success and the organisation of these Mutual Aid Exchanges was gradually extended over the whole country. Within a few months, more than 100 of these Exchange Centres met at regular intervals and several million tools were exchanged to relieve immediate production bottlenecks.

Yet another scheme, which really extended the idea of this Mutual Aid Scheme, started right here in Wolverhampton, namely, the Wolverhampton Production Exchange. It went a long way towards achieving in the Midlands a very much better utilisation of plant than could have been obtained without it. Manufacturers met weekly and regularly. Each of the Production Ministries were represented, armed with full details of the work they required to be done, and of bottlenecks to be overcome, and these and other problems were discussed.

These and other purely voluntary schemes were supplemented by official bodies. We had Research Departments, Investigation Departments and special Training Schools opened up by the Ministry of Labour, but despite all these attempts we could never really attain the desired production, and I submit that the real reason for this was that plant and equipment were not being used to the best advantage. This was especially true in the Government-controlled factories, where a lamentable inefficiency was the rule rather than the exception. Many instances can be vouched for where Shadow Factories were taking 4, 5 or 6 times longer to manufacture a particular component than a smaller firm who had been making the identical part before the Shadow Factory commenced to operate. It was most discouraging to see the very best plant that money could buy being used at only "half-cock"—and what's more, deliberately

so. I personally know of many cases where machines were tooled up to produce a part at a rate of so many per hour and before the machine had been in the line any length of time the production times were deliberately increased—in other words, the machines were slowed down. There were all kinds of excuses why this should be done—such as shortage of skilled labour, shortage of supervisory staff, balancing of plant, etc., etc., but my main point is that if we are now to consider and act upon the best means of getting utilisation of plant, such practices as I have cited must not be allowed to continue, and I say that any individual—whether it be worker, shop steward, manager or anybody else—who is guilty of slowing down a machine or of withholding his very best efforts to get the best out of a machine, is guilty of sabotage and is a traitor not only to himself and family, but to his country in her hour of need, when she is fighting for very existence. It will certainly be a long time before we get another opportunity to re-equip our factories with such grand machinery and equipment as we had in the war years. Much good equipment is still available in our factories and in the country generally and we have no reason at all to blame the present equipment for lack of productivity. Productivity can be increased only by increasing utilisation of machines which enable the worker to multiply his own output. We can increase employment in this country only in proportion to productivity. The idea of limiting production in order that some more jobs can be maintained is one of the shibboleths that should and must be replaced by the idea that BY INCREASING PRODUCTIVITY NOT ONLY CAN MORE JOBS BE MAINTAINED, BUT ADDITIONAL JOBS CAN BE CREATED. How can we possibly solicit business from abroad if we continue to have on our books goods for delivery in say 20 months (and in many cases it runs into very much more than 20 months)? Whether we like it or not, there is no short cut to success and prosperity. Today the only way to full employment is by harder work. Only sheer physical effort can hold the line while the re-equipment of industry proceeds.

2. Lost Machine Time Factor.

The frequency of and the time taken for machine change-overs varies considerably according to the type of production and the class of labour undertaking this work—*i.e.*, trainee, setter-operator, or skilled setter. All the time the machine is not in operation, the percentage of overall productivity is proportionally decreasing.

3. Reducing Setting-up Time by Pre-Planning and Preparing Next Job.

When a machine needs the services of a skilled setter to take care of the change-over from one component to another, machine time can be rapidly lost if the setter is not available immediately. It is

desirable to arrange production so that as many components as possible are machined before breaking down to set up on another one, and steps should be taken to see that when one job is completed and cleared from the machine, the next is on the spot together with all necessary tooling equipment. This needs careful planning, and in the case of small quantities is not so easy to accomplish, but is well worth while spending a little time planning.

Planning schedules should be supplied giving full particulars of the operation to be performed, indicating cutting speeds, feeds etc., so that the operator is ready to commence at once, thereby avoiding time lost in making enquiries from foreman, chargehand or setter in regard to the method of operation.

In the case of automatic or short cycle time machines where an operator has a number of machines under his control, they should be so balanced to give the maximum amount of machining hours in order that the operator is waiting for the machine and not the machine for the operator.

To obviate any likelihood of machine breakdowns, arrangements should be made for a periodic inspection of plant and any repairs needed should be dealt with immediately so as to avoid major repairs at a later date if possible.

The piece-work rates and time study etc., must be looked at and where necessary revised, with the object of ensuring that maximum production is obtained.

4. Toolroom Service.

It is imperative that the Toolroom Superintendent should be in very close liaison with the Production Engineer, to ensure that fixture and tools are available at the stage where they are needed.

Carbide tipped and kindred type tools are in greater use than ever today and the grinding of these requires more skill; and in order to maintain their cutting efficiency it is essential that a good class of labour is employed in the toolroom. All cutting tools after use on production should be returned to stores via the toolroom inspection so that they can be reconditioned before they are returned to stores. Periodically the jigs and fixtures should be inspected to ensure that they conform to the standards required.

5. Tool Store Service.

The Tool Stores should be centrally situated and preferably adjacent to the Toolroom. Where tools are used in conjunction with a jig or fixture, the tools and fixtures should be placed in a compartment clearly marked with an index number. The tools for each class of machine *i.e.*, Capstans, Lathes, Millers, Drillers, etc., should be stored in separate compartments. Micrometers,

adjustable Gap Gauges, Verniers etc., should be periodically sent to the Toolroom Inspection to be checked for accuracy, and on no account should anything from the Stores be retained by the workman after the job is completed.

Toolroom and Tool Stores Service must be organised with the main idea of seeing that the workers and the machines are equipped with material as and when required and that no holdup is caused through lack of proper tools at the proper time.

6. Making Use of Recent Developments and Value of I.P.E. in this Direction.

The Research Department of the I.P.E. has now been incorporated in an organisation named Production Engineering Research Association of Great Britain. (P.E.R.A.) This Association provides for the smaller manufacturer the same resources as are available to the larger manufacturers who have their own Research Departments. With P.E.R.A. all other organisations are in a position to obtain first-hand knowledge of up-to-date inventions and methods, propagated through lectures to the various Sections of the I.P.E. Dr. D. F. Galloway has stated :—

"Even if research facilities are greatly extended and research greatly accelerated, these facts alone will not solve our national problems and produce automatically the great technical advances which must be regarded as a post-war essential if Britain is to keep pace with other industrial countries. Research in itself is not the aim. *Only effective application of the results of research will achieve the end we desire.* This final step, the application of the results of research, lies in the hands of the Works Engineers, product designers, machine tool and equipment designers, production engineers etc. Research results are potential weapons of industry, *but they are only useful if they are* made available in the right place at the right time. The right place is where the job is planned and carried out and where the machines, equipment and tools are made. The right time is usually as early as possible, for in production research we have to face hard facts of production engineering practice, where the time factor is of paramount importance."

Already many industrial and Government organisations have benefited from the work undertaken by the original Research Department in wide and varied fields. This work has included :—

1. The development of Lathe Tools and Drill Dynamometers and other special testing and measuring equipment.
2. Fundamental drilling research, with particular reference to the $\frac{1}{8}$" drills adopted as a representative size, but extended to cover drills from about $\frac{3}{16}$" to over 1" diameter, machining materials covering almost the whole range of engineering products.

3. Fundamental turning research, including both rough and finish turning. Diamond, carbide, ceramic, cast alloy, high speed and carbon steel tools have all been employed on a similar range of materials to the drilling tests.
4. Much of their time and facilities have been expended on research and development work in the field of Surface Finish Measurement covering the theoretical, inspectional and practical generation aspects.
5. Considerable amplification has been made of the original Machine Tool Acceptance Tests published by Dr. Schlesinger in the 20's. This work, involving field research and extensive tests, has been published jointly by the Institutions of Production and Mechanical Engineers, as Acceptance Test Charts for Machine Tools, Parts I and II.

This work is being continued.

6. Over 30 investigations from comparison of tools and cutting fluids to vibration tests have been made for industrial concerns and Government Departments. One interesting investigation was the development of a special cutting tool for use in the disposal of bombs.

The publications of the Department apart from reports to individual firms, have included :—

"Report on Surface Finish."
"Machine Tool Research and Development."
"Accuracy in Machine Tools."

Numerous lectures have been given by members of the Department, including such papers as Dr. Galloway's "The Practical Application of Surface Finish Measurement", "Machine Tool Research and Development" and "Recent Research in Metal Machining".

P.E.R.A. have recently published a booklet entitled "Research Plan", giving an indication of their purposed activities in over 30 phases of research and development, including Laboratory and Field Research, the collection and collation of existing information and the operation of a library and information service.

One important part of the plan which should be given emphasis within the scope of this paper, is the intention to provide facilities at the Research Station for delivering periodical series of lectures and demonstrations to groups of Apprentices, Inspectors etc. from member firms. It is to be hoped that they will continue the practice of the original Department whereby technicians from Industry were given periods of training in research and development technique—all services and methods being freely offered.

One scheme for the better utilisation of the facilities and the cheapest, is the efficient circulation of current technical periodicals,

proceedings etc., and the tabulation and filing of information of particular interest for future reference. But, unfortunately, in the bustle of engineering production, this practice is often curtailed by immediate needs. With all but the smallest firms it should be possible to prepare, duplicate and distribute a regular bulletin of abstracts including such selections from the fuller published abstracts of the I.P.E., Iron and Steel Institute etc., as are applicable to the organisation's particular interest, with possibly the inclusion of abstracts from technical representatives' reports of problems and technique in other organisations.

It need hardly be pointed out that it is the duty of all those engaged in industry, both Management and Production, to keep in contact with the various services offered by P.E.R.A.

7. **Training Operators to get the Best Out of Plant.**

Production Engineers generally realise the necessity of having a set plan to work to, but how often is the training of labour really planned? To enable this to be successful it is important that the supervisory staff and tradesmen should co-operate to the full. When young boys are sent into a section for training, they must be trained and not just used for doing odd jobs, as if this latter course is pursued a boy with initiative will soon become disinterested. Periodical progress reports should be made out on a standard form by the supervisor. If attending a school or college, arrangements should be made for periodic reports to be submitted and, if good, a congratulatory note should be passed on to the trainee. Today we are in the midst of an industrial boom with an acute shortage of trained labour.

Apprenticeship schemes should be reviewed and brought up to date, with the emphasis on "learning a trade" instead of "serving time". You can serve time in prison but you cannot always learn a worth-while trade there.

8. **Equipment—Provision of Workstands, Tool Cabinets, etc.**

The supply of suitable equipment, such as workstands, tool cabinets in the proper places, and properly organised Inspection Departments are most important.

9. **Remove Finished Work Quickly.**

A system should be devised whereby finished work is removed clear from the operator quickly to leave him free to start off on the next components.

10. **Line Production ? Trade Union Attitude.**

There are a number of Trade Unions involved in the different branches of Engineering, and each adopts the attitude towards

different methods of Production as may seem best suited to safeguard the welfare of the Labour employed. For instance, by the nature of things, the method of production in Sheet Metal work must be different from Machine Work.

Trade Union policy varies as industry develops to meet the changing conditions of world markets and the application of scientific discoveries. A glance at the number of patents registered within the last ten years will show the gradual change in methods of production. The Trade Unions have also taken into account the attitude of skilled mechanics to the introduction of semi or unskilled labour. It has been found that with the progress of modern engineering, production in larger quantities of components with a very high degree of uniform accuracy has been made possible, whereas the older craftsmen could make only a few components of comparative accuracy; and it is gradually being realised that the introduction of machines does not do away with skilled men, but enables industry to use the services of unskilled labour. The more complicated and efficient a machine becomes, so a higher degree of skill is required from the man who sets up and supervises. Where line production is essential to the development and growth of a particular industry, then the Trade Unions accept it as inevitable.

11. **Importance of Plant to the Nation.**

A very important factor in the proper utilisation of plant and one that must be considered anew in a realistic and practical manner is that of depreciation. Depreciation and obsolescence are familiar terms to industrial users of plant. The terms are latitudes apart in meaning but they are too often confused in their interpretation by operating men on the one hand and financial executives on the other. In brief, the underlying reason for this confusion of language might be summed up as follows :—

Operating men think more in terms of obsolescence than in terms of depreciation. Obsolescence is an operating reality. Depreciation is an accounting procedure. There can be no rule of thumb answer to the question of the life in years of a particular machine tool. The machine and the work it performs are the factors determining its depreciation. It is unwise to take a whole plant of machine tools and put them on a uniform depreciation basis. Some wear out sooner than others because of their nature or the extent of their operations, but more important, some may become obsolete far earlier than others. In the ordinary way it is in the national interest to set a short period of depreciation for equipment. This would clear the way for our plants to maintain the highest possible manufacturing efficiency, and is the road to lower manufacturing costs and ultimately to a higher standard of living. Management must not only recover its original investment but must

set aside an additional reserve, since experience over the years has shown there is a constant improvement in plant and equipment which is generally accompanied by higher prices. No company can keep its equipment in shape these days unless it keeps individual depreciation schedules for each machine, and measures its depreciation, not upon the basis of physical life, but on the basis of obsolescence, and the wise handling of depreciation policy has a great deal to do with the maintenance of employment and the prosperity of the nation.

Modern plant is the most important factor and industry's main instrument for reducing costs, but it reduces costs only by increasing output and by doubling and re-doubling the productivity of the individual worker. This does not mean that the worker must work twice as hard. It is up to everyone to see that the maximum production is being obtained from the machines, equipment and other plant that is available at the present time. For instance, if a machine tool is obsolescent, it is in fact a high cost luxury and thus the bitter enemy of maximum productivity. When we understand this and appreciate what it means to our country, our companies and our employees, we shall be on the way towards solving some of our problems of wages, prices and production. Before we dare say today that any machine or plant is obsolescent, let us first make sure that it is being used to the highest peak of efficiency, and when it appears necessary to purchase a replacement or additional new machinery, let us make sure that the new machines are going to give better and more efficient service than the ones we are discarding. Everything depends on our facing up to this question in the most practical and honest fashion possible. Give the designers and manufacturers of new machinery something to go at—do not be content with allowing them to furnish you with a machine that will produce only half what you know should be produced by a machine properly designed for the purpose, because don't forget obsolescence is the decline in value of existing machinery and our plant does not become obsolescent until such time as it can be replaced with new and better processes. It therefore behoves us to make sure that our present plant is being used to its maximum efficiency before replacing it.

12. **Plant in Relation to Labour.**

Now with regard to hourly wage rates and jobs. The idea of hourly wage rates arose in the days when time was in fact a fair measure of productivity, but today this assumption has completely gone by the board. The tendency today is to work as little for as much money as possible. This is a reflection of the overall Union ideology that there is only so much work to be done and unless it is spread out to the greatest possible extent there will not be enough

jobs to go round. It is exactly at this point that we arrive at a head-on conflict between industry's concept of created jobs and labour's concept of created jobs. Labour's idea is that by limiting productivity more jobs can be maintained. Industry's idea is that by increasing productivity not only can more jobs be maintained, but additional jobs can be created. Without dwelling too long on this controversial issue, let me tell you that I believe in any event hourly rates are not a fair measure for compensation under our volume production system. I don't think we should go back to the straight piece-work system (which was abused in the past years by many manufacturers) but I do consider that we should work out some method whereby, by mutual agreement, men's pay should be determined more by their output and less by their time-clock records. Productivity is the key to steady employment and unless the philosophy of limiting productivity can be defeated, we stand to face a steady decline in the invention and development of new devices and new equipment, a slowing down in scientific advancement and a retrogression in our standard of living. Another point is that we must make sure that the workers have plenty to work at. There is nothing clever about keeping information up our sleeves and keeping the worker guessing as to how much work he has in store, where his next job is coming from, or whether he is going to be out of a job, or have plenty of work to do. There is a tendency at the present time to limit our work and base production on what has been done previously. For instance, if at the present time our production is say 10 a month and we have received orders for export and the home market up to say 200, unless we utilise our plant and increase our production by all means in our power, we have orders on our books for 20 months' work.

At first this sounds very good indeed, but I contend that it is nothing to be proud of and on the contrary we should be ashamed of it, and take steps to ensure that the 20 months' work is done in 10 months or even less. According to the nature of the product, ancilliary equipment may have to be purchased from outside sources, such as castings, steel, raw material, motors, ball bearings etc., in which event orders should be placed at the earliest possible moment to enable the manufacturers of these items to prepare in turn their programme of production. Do not allow the equipment to be delivered at the rate of 10 a month for 20 months to meet past production rate; rather step up production with a view to making 20 times as much during the next month. In other words, we should not content ourselves by smugly thinking that we have 20 months' work in hand—but think and plan to do 20 times as much work in the next month ahead. Furthermore, tell all the workers about it, get the material to their machines and to their benches, pile it around them

and let them realise that they have something to work at and that there is plenty more coming along if they can get this out on time.

13. **Factory Layout, with Particular Reference to Moving and Handling Material.**

Special consideration should be given to special versus general purpose plant, depending upon the type of product and the setting up and planning of each operation.

The layout of the plant would be different for each factory and product.

The position of incoming and outgoing stores and the movement of materials from one department to another must be carefully planned so that the distance travelled is reduced to an absolute minimum. A vast amount of money is spent each year moving goods about the plant and the wages for truckers, elevator operators, crane operators etc. constitute a big overhead expense.

The following excerpts from the White Papers recently issued by the Minister of Labour and National Service recognise the need for more production but they do not go nearly far enough :—

"The great need of this country, as indeed of practically every other country in the world at the present time, is for a considerable and sustained increase in the production of goods of all kinds—of consumer goods and of capital goods, of goods for domestic use and consumption and for export."

"This policy requires improvements in the efficiency and the productivity of British Industry, and these are NOT the responsibility of the Government alone, but of industrial management and workers alike. It is for all concerned with industrial production to apply themselves to this task of improving efficiency and output in the realisation that the common good of the country as a whole depends very considerably upon their efforts."

"The biggest problem is the almost universal shortage of manpower. This affects everything. There is far more work to be done than there are men and women to do it."

"The answer first and last is by increasing production. This is the only means by which we can achieve a genuine and permanent balance between the value of purchasing power and the supply of goods available. Everyone has a part to play. The responsibility does NOT fall upon productive industry alone. It is as necessary to increase the WORK DONE PER SHIFT in the central and local Government services, in public utility and transport services and in the distributive trades as it is the manufacturing industries."

A newspaper editorial aptly comments :—

"No one denies that the Nation must produce more. But the Nation includes the Government. We cannot afford to have over

2 million people employed in Public Service, and we cannot afford to have a proportion of the administrative force of industry diverted to the task of coping with Government Departments or, as in the case of P.A.Y.E., doing their work for them."

Adam Smith's ideology was based on "the obvious and simple system of natural liberty". The Government—or "sovereign" should not try to regulate the industry of the people "in the attempting to perform which he must always be exposed to innumerable delusions and for the proper performance of which no human wisdom or knowledge could ever be sufficient". Smith thought that "Governments are always and without exception the greatest spendthrifts in the Society". Intervention by the State ought only to be tolerated where individual action is impossible. Smith was ready, however, to admit exceptions and in this he allowed more scope to Government than did later economists.

While arguing that controls are necessary, the White Paper admits that controls cannot do everything. It ignores the fact that a substantial labour force is needed to operate controls.

The Government has stated that work and economy are the needs for today. Let it set the example.

To conclude I cannot do better than quote from an article in the *Times*, Saturday, 22nd February :—

"The Trade Unions hold the fate of the country in their hands, even as the R.A.F. held it 7 years ago, but at the same time it is the responsibility and also the privilege of the Government not only to lay down the order of battle, but to lead the attack. This they have not yet done."

This is a clarion call to *you*—not to the population at large, not to somebody, somewhere, but to YOU, and YOU, and YOU and ME—COUNTRY FIRST.

With acknowledgments to :—

Mr. J. Trecker, Milwaukee, Wis., U.S.A.; *Times*, Saturday, 22nd February, 1947; Economic Survey for 1947, White Paper presented by Minister of Labour and National Service, etc., etc.

PLANT AND EQUIPMENT GROUP.

JOINT DISCUSSION

CHAIRMAN: Mr. H. BAINBRIDGE, M.I.P.E.

At the discussion in the afternoon, Mr. Ayres raised the question of maintenance of machine tools. Quarter of an hour, or even half an hour, was allowed to operatives to clean their machines, but with the shortage in man-power, and the consequent shortage of executives and charge-hands, it was difficult to see that this work was carried out. Present-day operatives did not seem to care about their machines; they seemed to be there to get as much as they could for as little work as possible. Did Mr. Hancock know of any scheme that would ensure that operatives carried out the normal maintenance and cleaning down of their machines?

MR. HANCOCK replied that in his paper he had referred twice to training and education, and he would probably make many references in the discussion to America, where he had made quite a study of training. The training of American workmen was something they had to watch very carefully, and it would be a good investment for anyone to send their workers over to America to see what was being done. In America, a new man was not just sent into the factory to find the foreman and find out where he had to work. He was received by a receptionist, given lectures on safety, and trained for the job. That was a good example of training, because there were machines in American factories which a British factory inspector would not allow to run for five minutes, yet in most of the factories there was hung a "No lost time through Accident" Certificate.

In this country, we were rather inclined to do it the other way. We placed guards all round a machine, and then told the operator that she could not hurt herself; yet she seemed to find a way to danger. That was fundamentally wrong. The answers he would give to the problem put to him was that managements must face the question of training new employees. The cost would have to be increased, but ultimately it would prove to be a saving. They must regard the cost of training a new employee as a question of economy.

They need not necessarily go to America to see examples of good maintenance; there were a number of examples of first-class maintenance in this country. The difference was that if anything went wrong with machine tools in an American factory, it was regarded as seriously as a fire. Instead of having to ask the maintenance department please to come and see to the machine, it was a question of "Production first". That was because in America they had at the back of their minds the dollars and cents, the yield per foot, the jobs per hour.

MR. LLOYD, referring to the question of machine replacement, said that the view the Inland Revenue took on how fast a machine wore out differed from that of Mr. Hancock, and when considering machine replacement they had to take into account how much they would lose on the taxation side. Did Mr. Hancock know of any method of calculation whereby that could be brought into the works engineer's calculations, so that he could prove to his boss he was not getting something to which he was not entitled? Mr. Hancock had made out a good case, but if a firm spent say, 50 per cent. more on maintenance, it was immediately said they had made an additional profit, and it was very hard to convince the taxation people that that was not the case.

MR. HANCOCK said his advice on the taxation question was that works engineers should stick strictly to the practical side of the business, though they should be trained to be more cost-conscious than they had been in the past. Their previous background training had been from the "patch it up" point of view, rather than the study of the economics of plant maintenance. All maintenance engineers should study simple works accountancy so as to appreciate the cost factor in their approach to the directors. He would like to ask Mr. Lloyd whether he received each year, and received willingly, a report from his works engineer frankly setting out the state of his plant. He (Mr. Hancock) had submitted one every year for many years, but when E.P.T. was introduced, he found that this report received more attention. That was the state of mind he was deprecating, as it must be right to have one's plant in good condition, and it must be right to have reasonably modern plant.

On the question of taxation relief, Mr. Hancock said this provided relief of one-fifth in the first year, and five-fourths of ten per cent.—that was 12 per cent.—in succeeding years. Now, taxation officers are very much more responsive, and one could get an initial 33⅓ per cent. if one could make out a good case for a special machine for a special job. He quite agreed with Mr. Lloyd that they had to take advantage of as much relief as they could get in replacement of plant.

MR. LLOYD said the answer to Mr. Hancock's question as to a yearly report to him was "No".

MR. HANCOCK said he recommended the procedure. If his doctor told him he was suffering from a duodenal ulcer or some major defect he, at least, knew from what he was suffering, and from the same point of view, he strongly advised that every modern board of directors should have before them a frank statement of the state of their plant, which they must willingly accept. He emphasised the words "willingly accept", because if such a report was not welcomed, they would not get the truth. The directors

should know what their works engineer thought about the roads, the plant, the equipment, the stores, etc. The works engineer was a professional man—or should be—and his advice should be taken just as one took one's doctor's advice. Whether one had an operation or not was entirely for those in charge to decide, but at least it should be known what was the matter.

MR. MACLAREN said there were three ways of looking at the question of new plant. The man selling it had to prove it would pay for itself in three years. When a man bought it, the ordinary period before obsolescence was seven years. When it got into the shop, it was left there for twenty years at least. They had to reconcile those three things to answer Mr. Lloyd. It was the job of the man in the shop to know when a machine became obsolescent. On the graph for special welding plant mentioned by Mr. Hancock, the lines crossed at two years, but on other machines it was usually five years, and at the end of that five years the management should be covered and have enough in reserve. It was the job of the man in the shop to say when a machine was losing out against competition, and if it became a question of new equipment or new plant, the management was morally bound to put in better equipment, and they should plan their finances to do it.

Depreciation was an accountant's job; an accountant did not worry about obsolescence. In every shop there were some old machines that had depreciated for a very long time, but they were as good as machines that today would cost five times their price. Today, it was morally and ethically wrong to put a machine out at the end of seven years, just because it had depreciated—if it could still do as good a job as it should. If it could not, then it should have been put out at the end of two years, or never put in at all.

MR. WILSON, who explained that he was not a member of the Institution but an economist, said he would like to thank the Institution for the assistance they had given him in the research work he was doing. He was interested in one point Mr. MacLaren had made—the elimination of the traditional stores on the batch system of production. Would Mr. MacLaren be good enough to enlarge upon that point? He was not concerned with flow production, because the majority of the factories in this country were equipped for batch production. Could that system of entire elimination of the stores be applied to batch production?

MR. MACLAREN said he wished he could answer that question, because it was one that had cropped up in his own works. It was a question that was not only worrying him, but worrying a lot of people. In his own works, they had a very beautifully set-out shop, but it was inadequate. They had their machine shop, then their centrally located stores where inspections were also carried

out, and the assembly shop on the other side of the stores. That is all right in theory. It would be ideal if they could manufacture the parts as they were needed, and they were gradually coming to that, even on the batch system. They would then use the stores only for parts needed as spares. If they could cut out the stores as far as parts going through the shop were concerned, they would be better off; it would not only cut out a system of cards and so on, but would release people who could be put on other work. If stores were needed for replacement, then they could let an extra batch go through. He was not talking merely of mass production; this applied to the manufacture in small numbers of large machines.

MR. HANCOCK said his description of inter-process stores in the flow of production was a stores that was usually full of unwanted goods. The solution he had applied to batch production was that of the mobile stores, *i.e.*, a conveyorised system which paraded the material in front of the assemblers for them to remove as they required. Many people regarded conveyors merely as a means of saving labour in the transport of materials, but a more scientific approach was to regard them as mobile stores as well. Used properly, a conveyor was more than a store; it was a good "progress man". It was surprising how production was levelled up if the conveyor became full and a rule introduced that no material must be on the floor. He had designed conveyors to give a certain length, so as to have a stores capacity for the minimum economic batch size, calculated on the time cycle for balanced sets. This was the best method, otherwise one would have a large investment in material lying idle.

American stores did not exist as they were known in this country. An American store was usually a clear floor without any racks, bins, dirty corners, etc. The material in these stores was handled by that new "labour of industry", the Fork Stacker Truck. Pallets were made up of balanced sets of materials—tens, twenties, or thirties, and so on—there was no counting, no checking, and no repeat paper work. The Fork Stacker would lift up a pallet of this material and either stack it from the floor or lay it by the operator.

That tendency should be followed in this country. Stand in any industrial area and watch the lorries going past and ask yourselves the simple question: "How did that material get on to that lorry, and how is it going to come off?" The answer is usually the same—one at a time. That was not so in the United States, where one could see the stacker trucks with batches of material on pallets going right into the lorries, and right into the railway trucks, stacking the material to the capacity of the vehicle. The only labourers they had in America were floor sweepers.

MR. WILSON asked whether some of the difficulties that had been outlined could be overcome by the reasonable introduction of

motion and time study. By motion and time study, he was thinking of tying it up with incentive payment given for the job.

MR. HANCOCK replied that everything could be time and motion studied, but there were certain time-beating elements. One would be surprised how a conveyor automatically levelled production, and where one had an operation holding up the rest, attention would be called to it. It could then be brought up to higher productivity rather than what was being done at present, bringing the rest down to the capacity of the holding operation. He believed in setting a rate of jobs per hour, setting the basic plant to do it, and boosting up the one or two laggards, rather than getting too far into detailed time and motion study—bring the possible average speed down. He strongly advised going for the basic speed, and letting the other minor operations more or less arbitrarily come into line with the main assessment of what should be produced off that floor space.

MR. SPENCER referred to Mr. Hancock's second chart dealing with welding plant. He thought that was based on a motor generator, and if Mr. Hancock bought a welding plant today, he doubted whether it would be a motor generator plant. He would most likely buy a transformer plant where there were no wearing parts and, consequently, no maintenance. Instead of the maintenance curve going up, it would be parallel. While on the question of welding, he wanted to hear the speakers' views on another aspect. Welding was very greatly developed during the war for saving material, and could now save considerable material not only in jigs and tools, but also in the manufacture of products on the right design.

MR. HANCOCK pointed out that he was dealing with special welding plant when he showed the chart. Special welding plant had been installed for specific purposes, and it had been found that by writing down that plant quickly, it had been an economy. He entirely agreed with Mr. Spencer on the question of welding. Welding was one of the modern servants to meet an end, and one of the best examples he could give of this saving of original material was a job they had done during the war. The centre-hub for a two, three, four or five bladed propeller was made originally from a large solid stamping. They developed, in conjunction with another firm, a method of pressing a plate of one-inch thickness into a half form, then flash butt welding two halves together. In this way not only was original metal saved, but all the time spent in hacking off this material in machines smothered in swarf was also saved. Masses of swarf on a machine was always a sign of inefficiency, because both man-power and electrical power was wasted cutting it off in the first place, and then the swarf had to be removed from the shop and taken away. That was a waste that should be avoided if at all possible.

MR. TYLER said two problems had been mentioned that day. One problem concerned the best use of man-power, and the other the economic utilisation of plant. It might be that he was wrong, but he believed that many of the costing systems had the key-note that the price for labour should be so low as to discourage the economic use of plant. Could Mr. Hancock give them a lead on that subject?

MR. HANCOCK said he had made his views clear on that point in his paper. The cost of an article was its ultimate cost, and as he had said in his paper, it was often found that putting a boy on the job with a low piece-work rate was not necessarily an economy at all. He did not believe piece-work prices were the whole answer to the question of cost economies; the yield per square foot per pound of wages paid per year was his complete formula, based on good standards. He would not agree with any system which only took into account the piece-work price, because that was only one element. The first approach to the question should be: "How many could be produced off the floor area with the plant?" Then one knew what one could afford to pay, and this should be a good standard. Competitive costs did not depend upon low wages, but upon modern production methods, provided labour was willing to use modern methods to the full.

MR. LAWTON said it might be of interest for them to know that the Americans had developed a system of injection moulding of steel (including stainless steel), so that the cutting tool was being eliminated. He did not buy machines himself, but if he did he would not feel inclined to buy equipment, especially special purpose machines, which would only work six hours out of twenty-four. They must have a two-shift system, but by that he did not mean they should have a night shift. As they had found out from experience, the night shift turned out more scrap than actual work, and the day shift had to spend its time rectifying it. Special purpose machines working ten or twelve hours a day would soon pay for themselves. This would be a good thing because the trend of engineering today was such that special purpose machinery soon became out of date.

Moving round the country as he did, he had found there were often hundreds of small firms making the same component, and there was plenty of scope for rationalisation in this direction. In this country a forging almost grew before their eyes. In America, they re-cut the dies more often, and kept the whole forging at the right temperature, instead of trying to give it another smack after it had got below a particular temperature. As a result, the forgings grew in size as the day went on, and if a special machine was designed to take a sixteenth of an inch off a forging, the whole set-up of the

machine was spoilt if it had to take off an eighth of an inch. He felt there was plenty of room for the control of raw materials both in quality and size.

Replying, MR. HANCOCK said he had recently visited the Republican Steel Corporation works at Cleveland in America. He was particularly interested in steel for deep-drawn pressed work, and he had asked the President about their association with the consumers of their steel. The first thing he found out was that this very big concern would not take an open order for sheet steel. They not only had to know what it was to make, but they had to have a drawing. Then two conferences were held.

At the first conference, the user had to explain why he wanted that particular shape of article, and after this general conference of explanation, a second conference was held. That second meeting was for the trial and proving and finding of the best type of steel, and not only were the supplier and user present, but also the tool designer. That was an outstanding example of the American method of the getting together of the suppliers and users. The same method applied to stampings, although America was gradually changing from stampings to the hot coining method in which they were working to very fine limits. The supplier of the stamping kept in much closer contact with the user ; he knew the type of machines the customer was going to use, and he knew that if the stamping reached a certain size it was no good.

MR. LAWTON said that was borne out in the machine tool trade in America, where the machine tools were developed in the production plants, and the snags were discovered in the actual production line. The user and the small toolmakers then got together. The products they turned out were the tools for which we were now paying excessive prices in dollars. In this country, the machine tool firm developed the tools in their own plant.

MR. STEVENS said they had heard a lot about America that afternoon, but he could tell them of a firm in Birmingham that made bodies for motor-cars. He first dealt with that firm nearly twenty years ago, and they had no stores of material. The material went into the factory at nine or ten o'clock on one morning, and was delivered completed the following night. That was an example of British organisation. Dealing with the question of drop-forgings, he said it was not more than twenty years since he first sold connecting rods which were guaranteed to within four-thousandths of an inch. The drop forging trade in this country was not generally so far advanced as that, but there were firms supplying drop forgings made from dies in the ordinary way which, even on a large quantity, did not vary one-sixtyfourth of an inch.

MR. LAWTON pointed out that it was not a case of being able to choose one's own drop forger. The trouble was they often had to purchase the same forging from half-a-dozen forgers.

MR. HANCOCK agreed there were exceptions. We did a lot of good things in this country, but we did not talk about them enough. That was one of the great uses of the Institution of Production Engineers—to give voice to these things and encourage people to go to these factories and see what could be done. The point Mr. Lawton made about having to go to different suppliers did not make any difference to the fundamental point that the supplier must know the needs of his customer and the plant and equipment he was using. The latest development in America was an eight-cylinder eight-throw crankshaft, made on the latest hot-coining process which eliminated all rough machining.

MR. STEVENS agreed that Mr. Hancock was perfectly right, and the only reason he had mentioned the British product was because he thought it time a word was put in for this country. Mr. Hancock had stressed time and time again, and would go on stressing, the need for contact between user and supplier. The only reason he (Mr. Stevens) had been able to supply drop forgings to the accuracy demanded, and in large quantities, was because he made personal contact with the users, found out what they wanted, and then went back and saw they got it.

MR. BAINBRIDGE said it was now time, unfortunately, to bring this part of the proceedings to a close. They had covered a great deal of ground, and had dealt with all the important aspects of plant utilisation. They had heard how America was dealing with its problems, and it was very important to see what the other man was doing, because in that way they learned a tremendous amount. America was very advanced in such ideas, and unless the production engineers in this country were not alive, America would get ahead. He was sure they were not going to allow that, and their Conference had shown they were very much on their toes.

A vote of thanks to the two speakers was proposed by Mr. Hilton, and seconded by Mr. Hynes.

LUNCHEON ADDRESSES

After the Loyal Toast, the President called upon the Rt. Hon. Lord Sempill, A.F.C., F.R.Ae.S., M.I.P.E., to propose the toast of "The Success of Britain's Post-War Recovery". He explained that Lord Sempill had been in Paris the previous day, and had not arrived at Birmingham until four o'clock that morning. That was an illustration of the interest he took in their Conference and in the Institution in general.

Lord Sempill said he was glad indeed to have been able to be present at the Conference. The President had referred to work he had done in France, and, in passing, he would like to make some remarks which were indicative of the way the French were facing the adverse situation caused by the severe weather. Everyone knew how troublesome the recent snowfalls had been in this country, and his Worship the Mayor had asked them if any technical arrangements could be made to deal with it. In Paris, by 7.0 a.m. the previous day, the whole of that great street which led through the Arc de Triomphe had been swept clear of snow. This was an indication of how the French were dealing with the many difficulties now facing them.

He felt that the Institution might have the benefit of some further suggestions and directives from their distinguished guest of honour, Sir Godfrey Ince, who had opened their Conference with such a splendid address. It was the finest speech they had ever heard at the opening of any Conference. It was the only speech he had heard in recent years from a man of Ministerial rank that treated the subject in a serious, forthright, and practical manner; he had told them exactly how matters stood, and what His Majesty's Government were expecting of production engineers. Sir Godfrey had admitted that they who practised the art and science of production engineering were performing an important task, but it was not nearly enough, and much more was expected of them. He was looking forward, as was their very good friend, Mr. Woollard, President of the Institution of Automobile Engineers, who was unfortunately unable to get to the conference in time for the opening address, to pondering on Sir Godfrey's remarks before an empty fireside that night.

There were several matters on which they had to ponder, and many questions to face as production engineers. First there was the application of science, technology, and acquired experience; secondly, the possession or acquisition of materials and capital equipment; and thirdly, the ever eager straining to produce more and better goods than before with the man-power (and, where necessary, woman-power) that was available. Lastly, and most

important of all, there was the need of the right spirit motivating them all, so that efficient use for the common good was made of that most precious and as Sir Godfrey had said diminishing quantity of material—manpower. He wanted to emphasise that point. Human progress, properly directed, could and did, bring happiness, but such would not be the case if they had, as in many cases at present, an ever decreasing effort from an increased return demanded as a right.

The materials and capital equipment had to be available. There were the materials within the Empire, and they would have to count on them to a far greater extent than ever before. The American loan in itself was not unfortunate, but it could be unfortunate for their children and their grandchildren if it were not spent wisely. It had been said that the loan was necessary to obtain capital equipment for industry. Nevertheless it was not very inspiring to see it being spent on tobacco, films, chewing gum, and similar commodities. He felt sure the public would understand if His Majesty's Ministers were to explain that we should have to suffer a reduction in American tobacco and have an increase in Imperial tobacco, or forego American gangster films until Britain was able to produce films of a better quality.

They had to get away from the false doctrines which had been pronounced so frequently in the past. The issue now before the nation was a simple one. In the years now long past we had enjoyed the highest standard of living of any country, but we had done nothing to achieve it and very little to deserve it; it was due to the work, the initiative, and the energy of our forefathers. We had therefore again to build up a future for our children.

The only means of achieving this was to take a leaf out of the book of our forefathers and "get down to it". Only by the application of initiative and hard work could we build up the standard of living we desired, and this would not be derived from the pompous speeches of Members of Parliament, nor from the passing of those acts of Parliament which were conceived in a particular ideology.

In a recent speech the President of the United States of America said that his country was enjoying a period of prosperity, and he looked forward to it being increased so that the people of America could have more benefits in the form of automobiles, refrigerators, radios, and similar comforts. The President said that this could only be accomplished by an extension of what he termed the Atlantic Charter Plan—a plan of freedom. If we desired, as we certainly did desire, to maintain our freedom then we did not want to encourage a wholesale extension of the bureaucratic machine as this did not necessarily make for efficiency. It should be remembered that more personnel were required to maintain that

bureaucratic machine than were required to maintain the armed forces of the Crown ; it gave them seriously to think. He ventured to suggest that if industry was given a greater measure of freedom from the many controls which now beset it, and a proper spirit was brought about between the executives and those who worked on the bench, many difficulties would speedily right themselves.

There were different methods of approaching work, and one way was that of the bus driver who, when asked why he worked, said it gave him the opportunity of getting away from the old women for eight hours or so a day. That was, of course, an understandable reason, though he was sure that no one in the room had that particular worry. The best approach was to have the joy of achieving something better than had been achieved the previous day or the previous year, and in doing work that would benefit their families and all concerned.

They would remember the Wolverhampton Conference for some time to come, and thanks were due to all who had taken part in organising such a splendid effort. They were glad to have the National President with them, and also Sir Godfrey Ince. He felt sure Sir Godfrey would have time to give them a further directive before he hurried away to catch his train, and it was with the greatest pleasure that he proposed the toast of "The Success of Britain's Post-War Recovery", coupling it with the name of Sir Godfrey H. Ince, Permanent Secretary to the Ministry of Labour and National Service.

Responding, SIR GODFREY INCE thanked the members very much for the way they had received the toast, and also thanked Lord Sempill for his kind remarks. Quite apart from the fact that he had to catch a train in 25 minutes time, he was going to be brief for a further reason—he had already inflicted himself upon them that day.

During the past three weeks our economy had been struck a most grievous blow, and our most immediate task was to get through this crisis and then to see whether it was not possible to turn that crisis to good account. Not only had we to recover the position of three weeks ago, but we had to make good the loss incurred during that time. That was of vital importance. If they looked on the brighter side they would see what the crisis had taught the whole country—it had made everybody coal-conscious. Whatever they felt about it before, the people now knew the fundamental importance of coal in the economy of this country and it had made them realise how very near the edge we were. Because the consciousness of the country had been fully roused, it gave them an opportunity to turn our present position to our ultimate benefit and advantage.

As a country we were never more alive than when we had suffered a grievous blow and appeared to the rest of the world to be down and out. It was then we showed our strength, and it was up to us now to show again the strength of the old country, the strength of the nation that fought alone against the greatest military might that the world had ever known, the nation that fought and won the Battle of Britain, and the nation that saved the world for civilisation. Surely such a nation was not going down now. They would, no doubt, have seen that during the past few weeks the New York newspapers had been busy burying the British Empire. What a profound mistake they were making! We had had an immediate response by the gift of £20,000,000 from Australia and £10,000,000 from gallant little New Zealand. That, he suggested, was a great inspiration, and a gesture from which we could take heart.

In 1940 we were fighting for our lives; today we were fighting for our continued existence as a nation. He was sure that if we looked upon our present fight in the same way as we looked upon the Battle of Britain we should get through. We were now entering upon a new battle of production, and in the forefront of that battle—the pilots of the new Battle of Britain—were the production engineers. We would run into some of the difficulties and some of the frustrations we had in 1940, but if we went forward with the same grim determination and the same high resolve he was sure we would come through. If we entered the battle of production in the spirit with which we entered into the Battle of Britain we would not only make a lasting recovery but, for the second time in seven years, we would astonish the world.

The toast of "The Institution, and particularly its Wolverhampton Section", was proposed by DR. W. E. FISHER, O.B.E.

He said it was a great honour to be entrusted with the toast of the Institution of Production Engineers, and though he well knew his own shortcomings as a speaker, he hoped this was one of the occasions when sincerity was enough to condone the lack of that lightness of touch so welcome in speeches which followed a good meal.

The Institution was founded in 1921, and they all knew of its many-sided progress since that date. The membership was now 7,000, and more than any other Institution they had effective provincial branches, of which Wolverhampton was one. The Institution was established as one of the major professional bodies of engineers, and the Institution had led the way in a significant reassessment of values in the engineering world. They had led the way, and the Institution continued to be a symbol of this "New Deal". He drew their attention to this point in particular, and to illustrate his point he recalled some of his memories as a teacher of engineering.

It was in August, 1914, that he first came into technical education, and it was during the first European war that he really learned to know part-time technical students. They were a first-class team, and under all the pressure of that first munitions drive—it was before research on industrial fatigue came along—they stuck to evening classes. There was no part-time day release ; instead, there was plenty of overtime. The students could not help coming late, but they did come. He was not saying that all the lads were like that, but he met some good ones, and he was reminded of them not so long ago when the Wolverhampton students kept evening classes filled all through the blitz.

With students of such enterprise and hardihood one felt that one must keep faith and must give them full value for their effort. He had found he had little confidence that he was doing so. He was giving them what they asked for in a limited, literal sense, but was he giving them what they needed ? He was, perhaps, helping one in a hundred along the road to an engineering degree. A degree was something of value—substantive value—irrespective of content, but what of the ninety-nine ? Was he helping those who sought to become draughtsmen ? Looking into it, he found that most of them would, in fact, need to be works-minded draughtsmen. There were plenty of University men like himself to look after developments in fundamental design, and to link design with latest research. The gate into this field was, indeed, open to his students—he rejoiced to say it was still open to such—but what were the probabilities ? Most of them would have needed exceptional personal ability, with influence or great good luck, to guide them through that gate, and he could not find his answer along those lines.

Ought he to think of his students just as potential skilled workers ? He decided not. Had he, in fact, been competent to give them skill, their scanty hours of attendance could clearly be put to better use. These were picked men ; their very presence postulated intelligence and pertinacity. He came to the conclusion that what these students wanted from him was nothing more nor less than the body of engineering knowledge on which their immediate bosses and more remote managers were, in fact, depending ; not what they had once been taught, but the actual knowledge of which these industrial brains were making daily use.

Few, perhaps hardly any, of these elders could impart their knowledge ; they were using it, but not objectively. Their knowledge was incomplete because it was picked up from casual experience, and not based upon ordered investigation and study. His students needed something better than the snippets of knowledge they could obtain from one and another ; they needed a sum total

in coherent, logical, scientific form—a whole which could be greater than the sum of the parts.

So he set out to write his first syllabus—one of the earliest—for an engineering production course. Like any other sane engineering syllabus, it included as much mathematics as needed to be used in the treatment of the central subject, and no more. It assumed, as the students' objective, technical responsibility in manufacture ; and it tried, quite simply, to teach the student what he therefore needed to know. It was strange how difficult, even wrong, it was to do this ; at least, he found it so. This was specialisation, and premature specialisation not built upon the sure groundwork of a good general engineering education. Was he not neglecting fundamentals ? He could never have carried it off but for the fact that he had been nurtured in the academic fold, so that his own fundamentals were not suspect. The answer to these reactions, given then and often since, would perhaps bear repeating once more.

It was true that every practice in technology must rest upon the fundamental properties of matter, and of specific materials, so the exposition of the practice demanded reference to the properties and implied their study. But it was not true to conclude from this that the elementary text-books and preliminary subject headings, or the order and arrangement of an older specialised course, ought necessarily to be taken over by a new one. The contents of these text books and syllabuses were, in fact, not general but highly selected. Was there, for instance, an elementary text-book on physics that did not omit a great deal that the young production engineer needed, just as it included much that he did not ? It was the weakness of workers in specialised fields that each looked upon his own as general and fundamental. As to what was fundamental, production engineering studies had, for instance, established metallurgy as a fundamental subject for engineers, just as other engineering courses established heat and thermodynamics.

Anyone trying to get together, to arrange, and to express an engineering science appropriate to students of those days had felt the lack of literature on the subject ; had missed that tradition of teaching and examining which is the effective definition of a body of study ; and had lacked the inspiration of a " growing fringe " of research. Today those needs had been met by the uprising of the Institution. He had never held a responsible position in engineering production, nor sought membership of their Institution (indeed, the programme went too far in crediting him with full membership of the Mechanical Engineers !), so he could properly say this : a majority of engineers were, in fact, production engineers, and to all production engineers the Institution had given the priceless gift of speech, with all its power to deepen and quicken thought.

Production engineers now knew that there was a great and important field of knowledge within which they were the experts ; other engineers accepted that fact. Production engineers were organising training and research ; they had organised this Conference on National Productive Efficiency.

Need all this have waited for their Institution ? It was enough to say that it had. Theirs was far from being the first learned body to stake out that particular claim—the ground was littered with neglected, decaying markers. No body save their own had effectively worked the claim, nor could have done, without neglect of more appropriate tasks. As long ago as 1661 the newly founded Royal Society set the fashion by commissioning John Evelyn to catalogue the mechanic trades for study by the Society. Today, a Fellow of the Royal Society was President of one of their own Sections, and had furnished a notable contribution to their proceedings.

Today it would be difficult for a young engineer to reconstruct the speaker's problems of 1914/18. That he could do so only with difficulty was a tribute to their Institution, and was, thereby, perhaps a justification to the speaker in taking time to tell an old tale.

There was no lack of justification for their drinking the toast he had the honour to propose—" The Wolverhampton Section with its able and enterprising President, Dr. Chapman ; and the parent Institution and their national President, Mr. Norman Rowbotham."

Responding, MR. N. ROWBOTHAM, C.B.E., B.Sc., F.R.Ae.S., M.I.P.E., President of the Institution, expressed his pleasure at being with them and at being asked to respond to the Toast. It was his duty, first of all, to thank Dr. Fisher and Dr. Chapman, together with their colleagues, for the wonderful work they were doing in laying the foundation stones upon which the production engineers could build the superstructure. It was the duty of the Institution to see that the youngsters, who were so well cared for by the Dr. Fishers and Dr. Chapmans of this country, were properly led through the channels by which they ultimately became efficient production engineers. He was sure the Institution would see to it that this work was well done. It was obvious, from the organisation and planning that had been put into their Conference that day, that the virility, the energy, and the enthusiasm of the Wolverhampton Section was outstanding, and he held it up to other Sections in the country as a very fine example to follow.

Turning to production, Mr. Rowbotham said that, whereas the objective that Sir Godfrey Ince had put before them was fairly obvious, there were other factors that were not quite so obvious. Production engineering during the war was an entirely different matter from production engineering now. Victory had to be achieved during the war at any cost, so the economics of production

were of very little moment. In the economic position in which the country now found itself it was an entirely different matter, and production had to be at minimum cost, not only in pounds, shillings and pence, but also in efficiency and economy of man-power. Not only were these factors different, but they had not the driving force of war behind them. Failure in the production drive during the war would probably have meant a very painful surgical operation carried out by the Hun, and it needed little imagination to visualise what might have happened to us. Failure now would mean a slow wasting away— a sort of tuberculosis of the whole community ; but that could not be realised so vividly as the drastic surgical operation which the Hun would have carried out.

There were other factors which were not conducive to efficient production, or, at any rate, which it was difficult to believe would lead to efficient production. The reduction in the hours of work and the availability of coal, electrical power, and so on were factors which were handicaps. He was not citing them just because they were obstacles, but only to bring to their notice the factors with which they had to deal. It behoved them, as an Institution, to see they provided a forum on which such matters could be discussed so that the knowledge already acquired by many of them could be handed on and used for the general good of the community. He believed that such conferences, of which they had such a fine example that day, should be repeated in the various other regions. By their aid they would be able to circulate data and useful information from one section to another, and this would be of national benefit.

There were also other matters on which they would have to advise, such as the machine tool trade, and whether specialisation or non-specialisation should take place. America had provided many specialised machine tools from which this country had benefited during the war in the production drive, and production engineers would have to advise how far this practice should be adopted by the British machine tool industry. There were many other factors for which the Institution must provide a forum.

Concluding, he thanked them on behalf of all the guests for the great hospitality they had received.

CLOSING SESSION

Chairman:

DR. W. A. J. CHAPMAN, M.Sc.(Eng.), M.I.Mech.E., M.I.P.E.,

(President of the Wolverhampton Section,
Institution of Production Engineers.)

The CHAIRMAN said that Dr. Herbert Schofield, who was to have given a general summing-up of the work of the Conference, was unfortunately unable to be present. He was sure that Mr. E. P. Edwards, who had very generously, at a few hours' notice, offered to take his place, would join with the Conference in regretting the absence of Dr. Schofield.

Mr. Edwards had been a member of the Council of the Institution for more years than he liked to remember. He was a Past President of the Birmingham Section, and Chairman of the Education Committee of the Institution. It would be impossible, to entrust the work of summing-up to anyone with a more orderly mind or better equipped to undertake the task.

In his opening remarks, MR. EDWARDS said he was sure that the audience would be indulgent with him, in the circumstances which the Chairman had outlined. Moreover, they would appreciate that it had not been possible for him to hear all the papers; unfortunately, he was only in one piece, and could not be in three places at one and the same time. Apart from what he had been able to hear, he had had to draw a little on imagination, and in one case he was able to read the paper beforehand. He proposed, in the few minutes allotted to him, to give his impressions of the Conference. He continued :—

" First of all, Lord Sempill in his opening address gave us a lead as to the importance of the Conference in relation to the problems of the present time, and the need for the right spirit of approach, particularly on our part as production engineers.

Sir Godfrey Ince, in his address on the man-power situation, on which he more than any man, perhaps, is in a position to speak with authority, urged the necessity of conservation of man-power and illustrated his point most strikingly by the decline in numbers of those attaining 18 years of age from 417,000 in 1939 to 335,000 in 1946, and prospectively to only 295,000 in 1950. That means that we must make the most effective use of the man-power, and particularly the young man-power, at our disposal. The vital need for exports to maintain a balanced economy was also emphasised by him, with supporting statistics, and for this reason the engineering industries will not be able to secure a greater proportion of the

available man-power, because other trades will have an even more desperate need of it. Sir Godfrey summed up the position by saying that our destiny is expressed by three Ms—Men, Management and Machines.

Coming to the papers themselves, and taking them in the order in which they are given in the programme, we have first the paper read by Mr. Berry to the Man-Power Group. He emphasised the importance of the last years at school, and the danger of " skimming the cream " and diverting it away from industry, into black-coated occupations instead of into actual production. He suggested a common National Certificate in Engineering taken after two years at the age of 18, and thereafter specialisation in education. He pointed out also the importance of the factory atmosphere in training, the danger of piece-work for those under 18, that teachers should graduate from industry, and that there should be organised refresher courses in industry. Industry should help, he said, in the provision of part-time teachers, and college equipment should be the subject of arrangement with industry, and should be kept up to date.

Mr. Briggs, who also addressed the Man-Power Group, said that men in themselves are not standardised. To know the mind of today's working force some knowledge of the background is necessary. Improvement in working conditions has brought a minimum of leisure and of security ; there has been a great development of mass production, coupled with a growth in the power of the trade unions. I think that Mr. Briggs had at the back of his mind that perhaps in the past legislation has tended to restrain what used to be called the " boss " or employing class, but that we are getting to a point where it may be necessary in some way to restrict—I say this with some diffidence—the too great power of the trade unions in relation to the community as a whole. In saying that, I am not in any way speaking disparagingly of the trade unions, which have, of course, very great power and a very great future before them, and which have been of inestimable benefit ; but we seem to be swinging rather from one side to the other, and I think that that is what Mr. Briggs wished to bring out. One of his conclusions was that Production and other Committees can do much towards success in achieving an identity of interest between the various levels of production, from the managerial level right down to the actual workpeople.

Coming to the Management Group, Mr. Puckey said that management must know what it wants to achieve in terms of performance and the measurement of that performance. There are many opinions but few facts ; one, however, is that at the present time we are working with an efficiency which is only about 90 per cent. of that of 1939. Organisation is of fundamental importance, and

may be defined as arranging parts to act as a whole. He emphasised the value of the proper use of an organisation chart ; this to management should be comparable to a map or drawing, and if correctly used will allow of analogies with a chess-board. There are too many overheads in industry and too few " undergrounds ". It is popular to refer to a growing bureaucracy, an increase in the number of civil servants, but industry is not entirely blameless in this respect. In this country only 19 per cent. of the population are direct producers, and they have to support a population of 47,000,000.

Mr. Lewis Ord said that in the early nineteenth century we had a low standard of living, which improved up to the outbreak of war ; since then it had fallen away, and was still on the decline. The previous high standard followed the Industrial Revolution, in which we undoubtedly led. We have lost this lead, and are facing a still lower standard. The popular impression that efficiency in America is higher is a fallacy ; the net results achieved here are superior. The output of labour has been restricted in this country for many reasons, whereas in America output is encouraged at all levels. The remainder of the gap is caused by an overplus of non-producers, by over-centralisation of industry, and by an excess of civil and perhaps municipal servants. Incidentally, an instance of that was brought to my mind in the newspapers yesterday, where there was a statement that 40 regional man-power boards are to be closed down and replaced by 60 ministerial offices having analogous functions !

In the Plant and Equipment Group, Mr. Hancock spoke of the necessity for an intelligent policy of maintenance and replacement of plant. He said that we should not attempt to squeeze the lemon dry. New plant must be used to its fullest capacity, and labour persuaded or coerced to support this policy. Attention is necessary in official circles to the need for more generous tax concessions in regard to replacement. He also emphasised the importance of eliminating storage space, a point on which Mr. MacLaren also touched, and said that there must be far wider collaboration between the user and maker of our manufacturing components.

Mr. MacLaren spoke about the utilisation of plant, and no-one is in a better position to do so. He emphasised that, following the White Papers, it has been left to industry to resolve the problems raised regarding not only the supply of plant but its proper and full use. Restrictive practices of all kinds, which may nearly amount to sabotage, must be discontinued. The manufacture of component parts must be kept in step with production, and there must be an avoidance of unnecessary storage, except for future and Service requirements.

That, very briefly, is a summary of the proceedings of the Conference.'

VOTES OF THANKS

The CHAIRMAN, on behalf of the Conference, thanked Mr. Edwards for his concise summary of its proceedings.

Before the Conference broke up, he wished to thank most sincerely all those who had contributed to it by speaking and by reading papers. He had heard praise of all the addresses, and the readers of them had done a very notable piece of work. He had sat in his office all the previous day waiting for telephone calls apologizing for inability to come, but he did not receive a single one from a lecturer. The other principal speakers had contributed very largely to the success of the Conference. He would like to thank the Governors of the Wolverhampton and Staffordshire Technical College for the facilities extended to the Conference. It was a pity that no time had been available for visitors to inspect the College, which well deserved inspection ; Wolverhampton was very proud of it. He hoped that many of those present would have an opportunity of inspecting it on some future occasion. To Dr. Fisher, Mr. Lovesdale Mills, Alderman Clark and the Governors he offered sincere thanks.

Finally, the Wolverhampton Committee had worked very hard to make the Conference a success, and he thought it would be agreed that a reasonable measure of success had been achieved. He would like to mention particularly the name of the Hon. Secretary, Mr. J. D. Smith, who had done noble work and had relieved him of most of the anxieties connected with the organisation of the Conference.

He wished to thank all those who had attended the Conference for their support. On Wednesday evening, due to the weather, he had felt pessimistic, and felt that it might be necessary to cancel the Conference, but the complications which that entailed were so great that it was decided to go forward, and the results had far exceeded his expectations.

MR. BUCKLAND, as a representative visitor, thanked Dr. Chapman and the Wolverhampton Committee for so generously inviting other Sections of the Institution to attend the Conference. Such a good thing the Wolverhampton Section might well have wanted to keep to themselves. The members from the Coventry Section had been very glad to come.

The Conference then terminated.

INSTITUTION NOTES

June, 1947

June Meetings

12th Glasgow Section. A visit to Messrs. Babcock & Wilcox, Ltd., Renfrew, has been arranged, starting at 7-30 p.m.

28th Birmingham Graduate Section. The Annual Summer Convention has been arranged, but full details are not yet available.

28th Birmingham Section. The Annual Summer Convention and Ladies' Day has been provisionally arranged.

July Meetings

19th Wolverhampton Section. The American Society of Tool Engineers, at the invitation of the Wolverhampton Section Committee, is sending Mr. H. E. Linsley to deliver an address and to convey a message of goodwill to the Institution of Production Engineers. Mr. Linsley is a past Chapter Chairman (Section President) and a member of the National Programme Committee of the A.S.T.E. The subject of his address will be "The Machine Tool and You," and slides will be shown illustrating some of the latest types of American machine tools. The meeting will take place at the Wulfrun Hall, Civic Hall, Wolverhampton, and will commence at 2. p.m.

Personal

Sir Claude Gibb, C.B.E., F.R.S., M.I.P.E., President of North-Eastern Section, is to receive the honorary degree of Doctor of Science from the University of Durham.

Mr. Tom H. Williams, A.M.I.P.E., has taken up the duties of Consultant and Technical Director to The Western Precision Co., Ltd., of Colwyn Bay. The Management of the Company has been taken over by Mr. J. V. Steele, A.M.I.P.E.

Mr. W. N. Job, M.I.P.E., has taken up an appointment with The United Africa Co., Ltd., of Nigeria.

Obituary

We deeply regret to announce the death of Mr. H. Johnson, Int.A.M.I.P.E., of Leicester Section.

Institution of Mechanical Engineers—Centenary Celebrations

As many members will be aware, the Institution of Mechanical Engineers is celebrating its Centenary this year, during the week commencing Sunday, 8th June.

On Tuesday, 10th June, a meeting will take place when an estimate of the present position and tendencies in manufacture will be presented in the form of three short lectures, as follows:

"Machine Tools," by Mr. A. H. Lloyd, M.I.Mech.E.

"Gauging and Metrology," by Mr. J. E. Sears, C.B.E., M.I.Mech.E.

"Industrial Administration," by Sir George Nelson, M.I.Mech.E., with Mr. R. T. Mattinson, M.I.Mech.E., as co-author.

The Institution of Mechanical Engineers has kindly invited the Institution of Production Engineers to be represented at this meeting.

Journal Stocks

Because of the severe paper restrictions, we are unable to carry a stock of Journals large enough to meet demands from non-members. It would, therefore, be greatly appreciated if any members who do not wish to bind their Journals, and are willing to relinquish them after perusal, would be kind enough to return them to Head Office. Any issue would be gratefully received, but the greatest demand at present is for the February, 1947, issue.

Issue of Journal to New Members

Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

Important

In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

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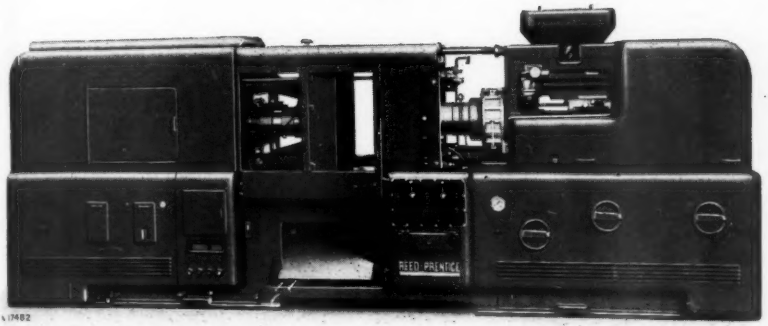

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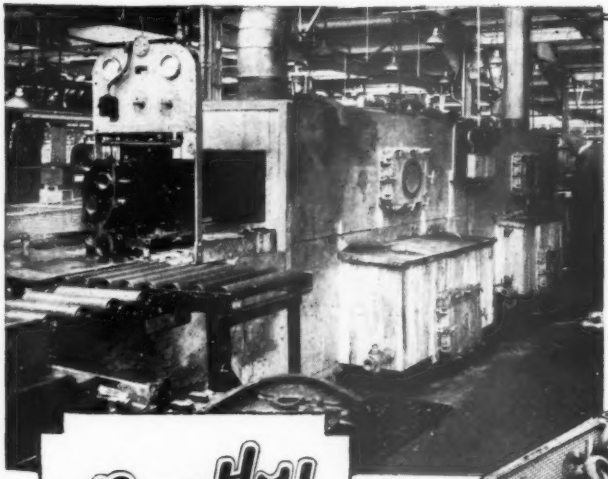

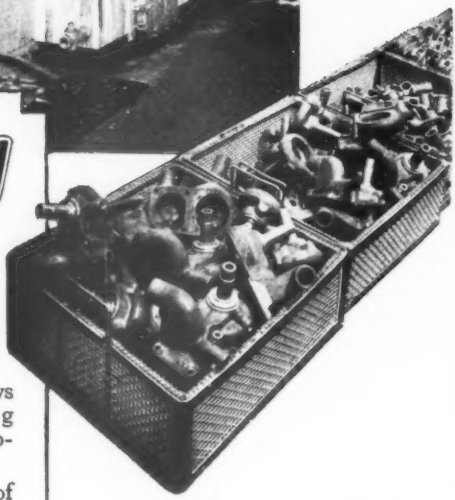

Bratby

INDUSTRIAL CLEANING MACHINES

This illustration shows a machine cleaning crank cases in the production line.

It is equally capable of cleaning small parts in baskets.

Photographs by courtesy of "Machinery."

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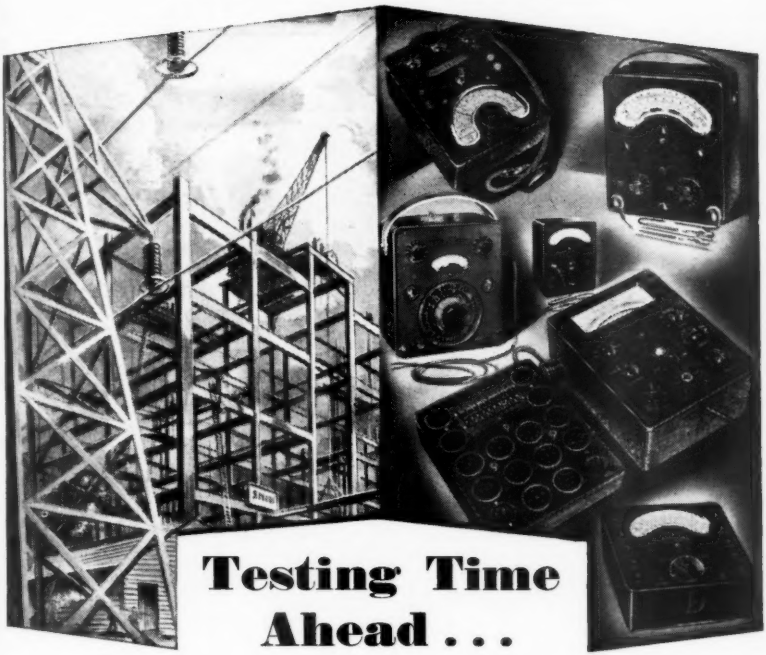

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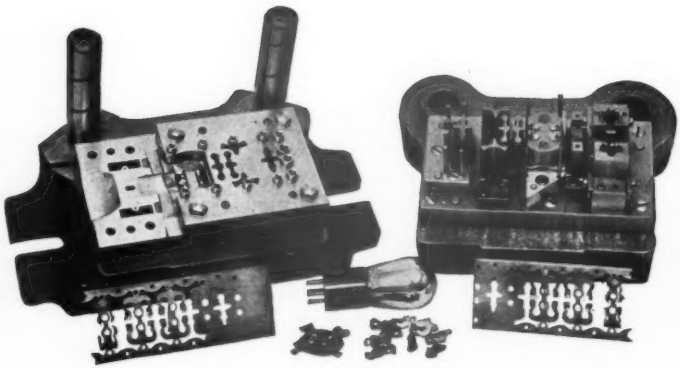

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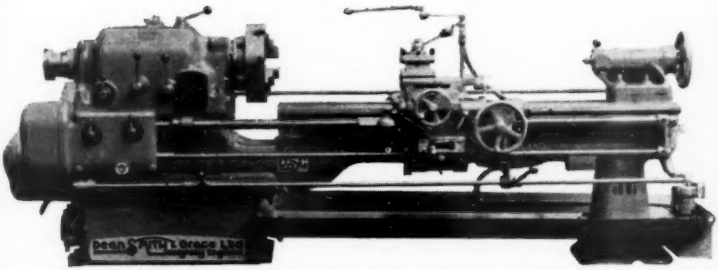

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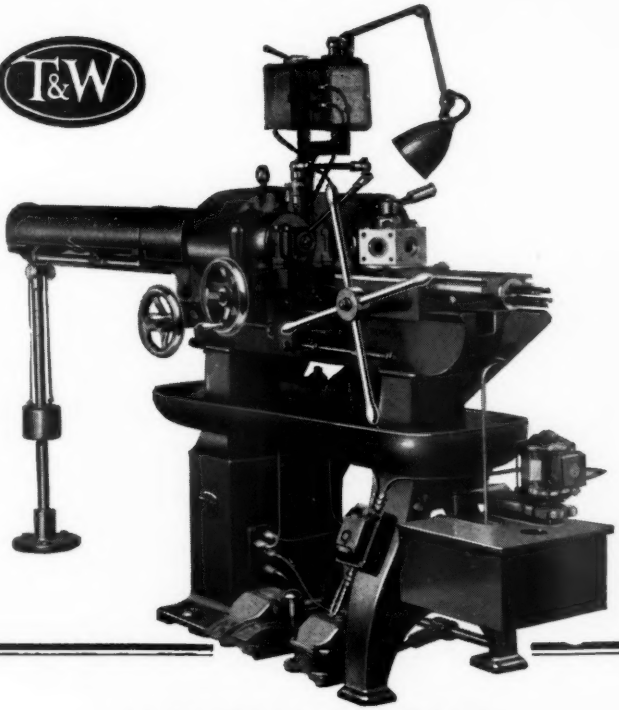

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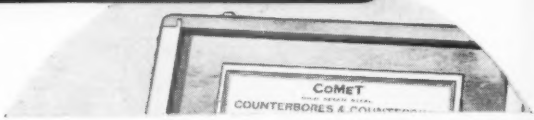

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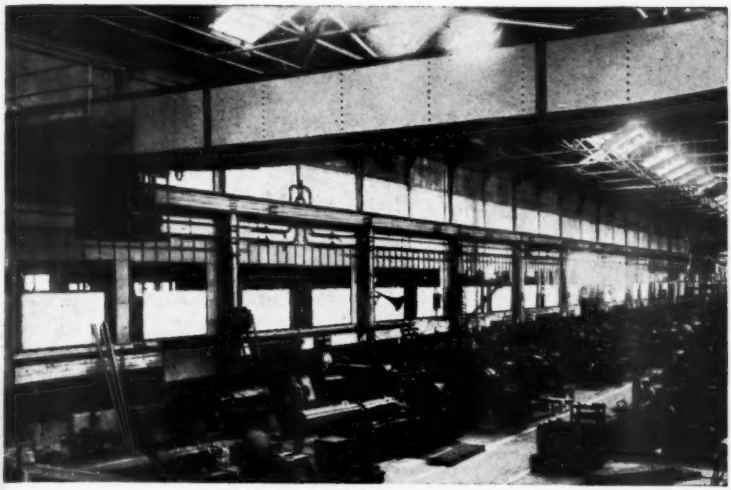

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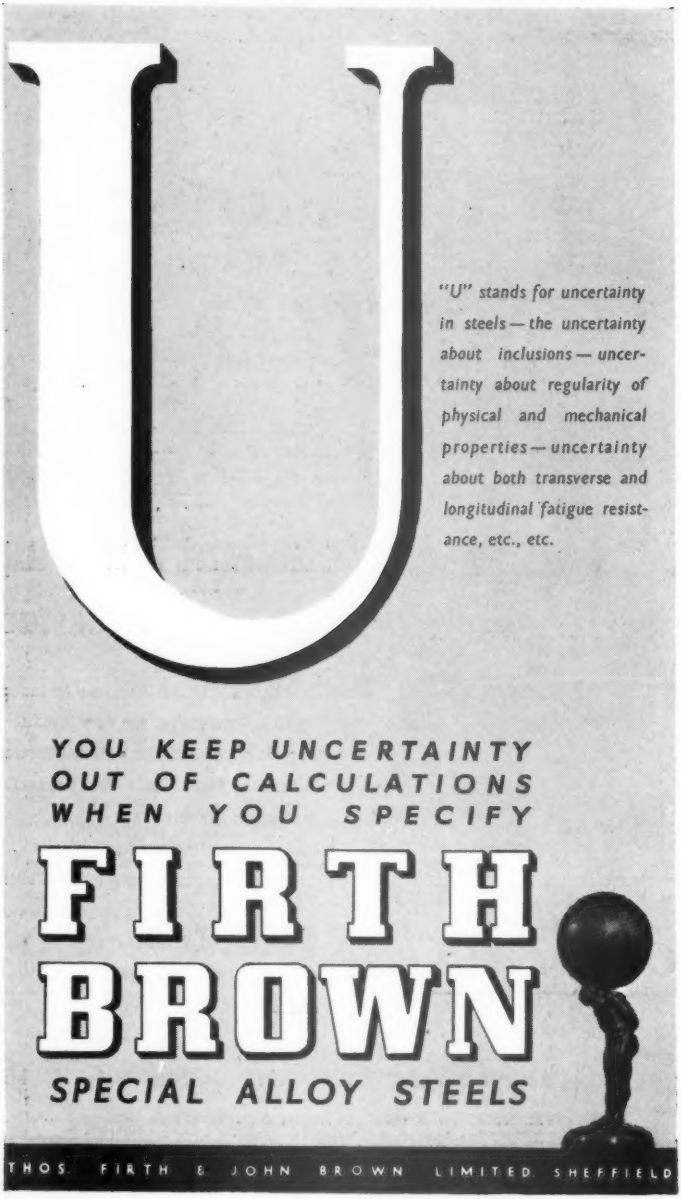
R.C.61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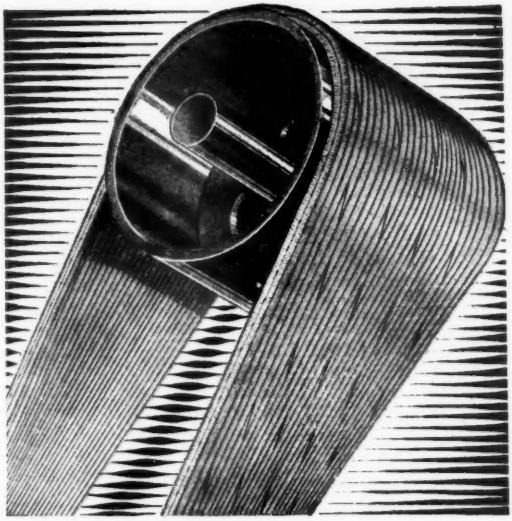

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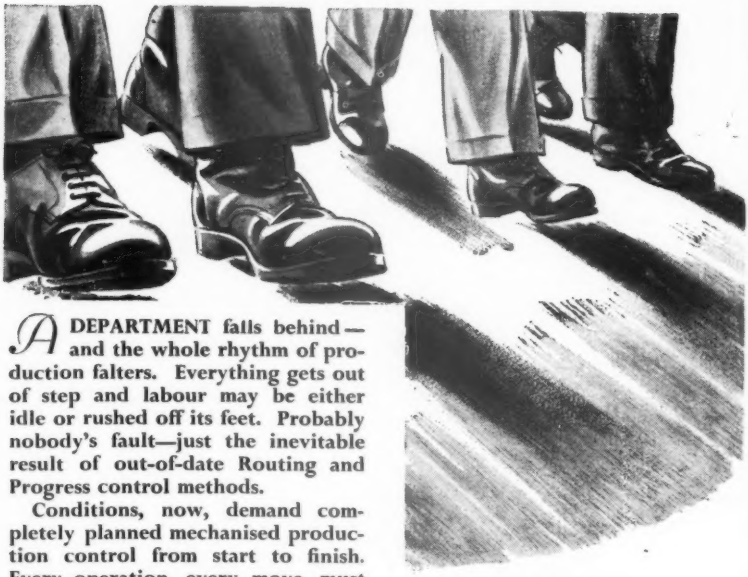

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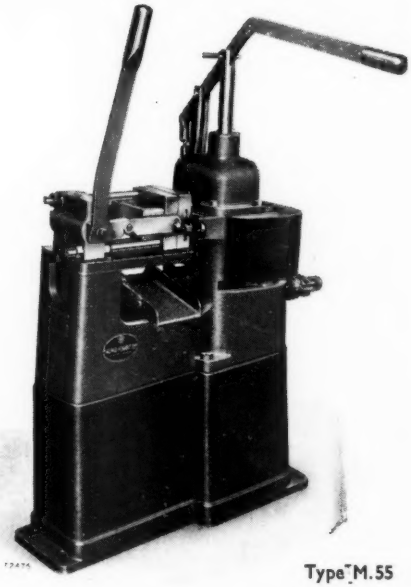

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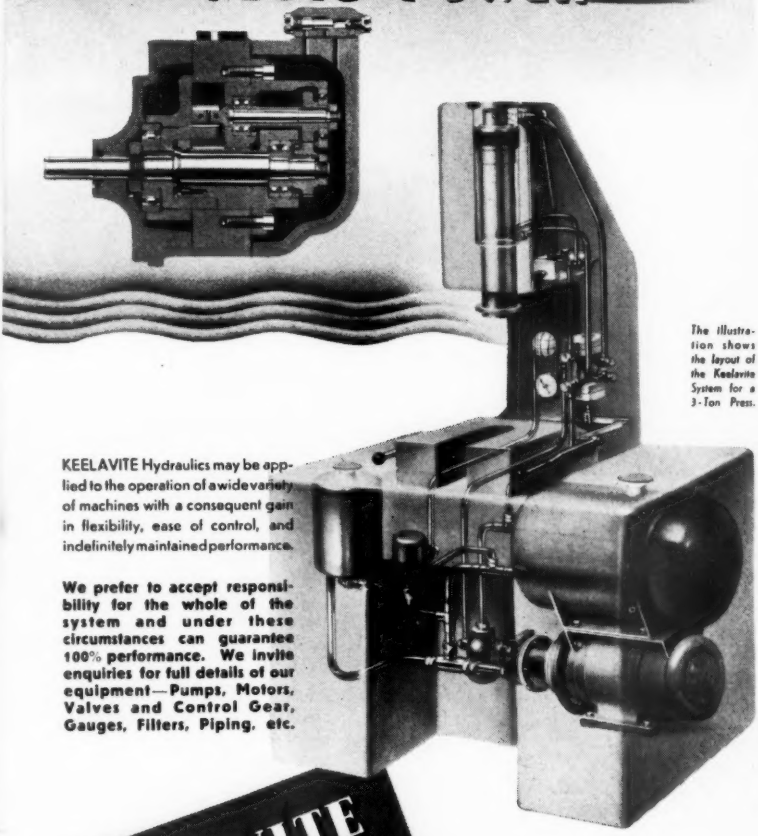

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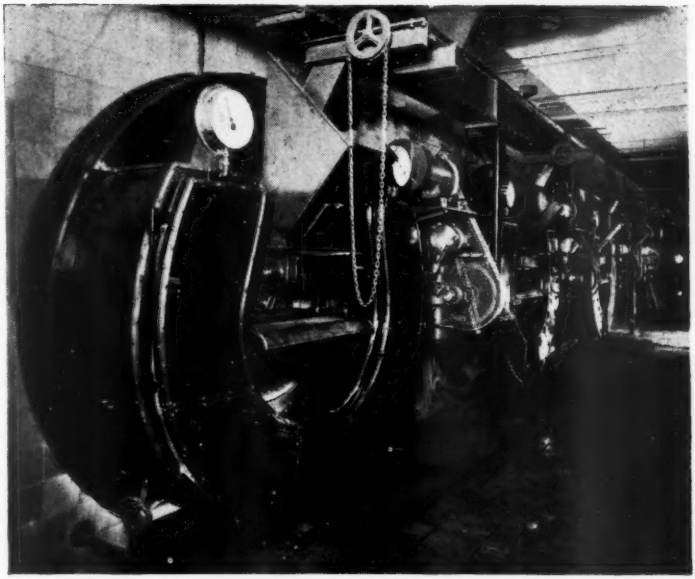

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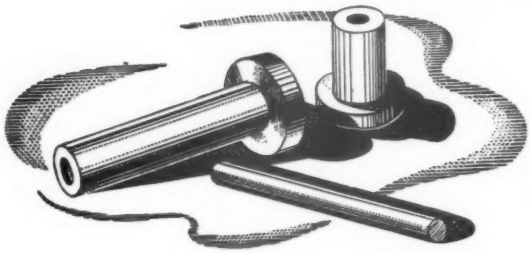

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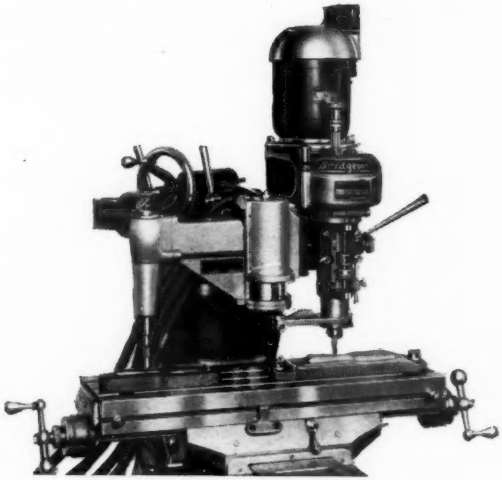

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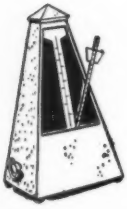

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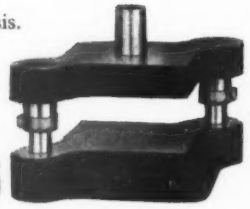

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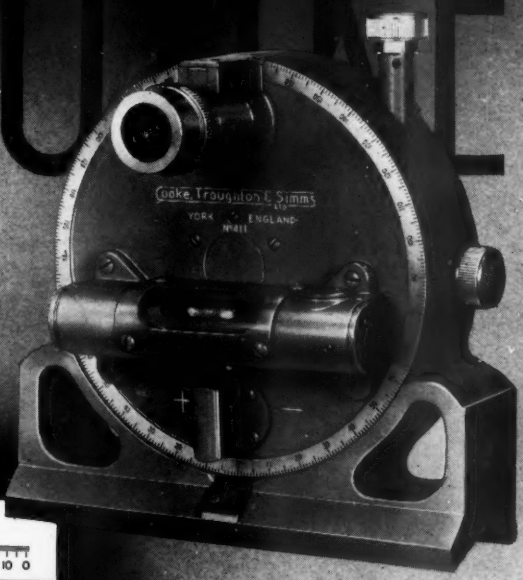

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The Filament Lamp is based on the principle that certain metals can be made to glow by passing an electric current through them.

COMPONENTS

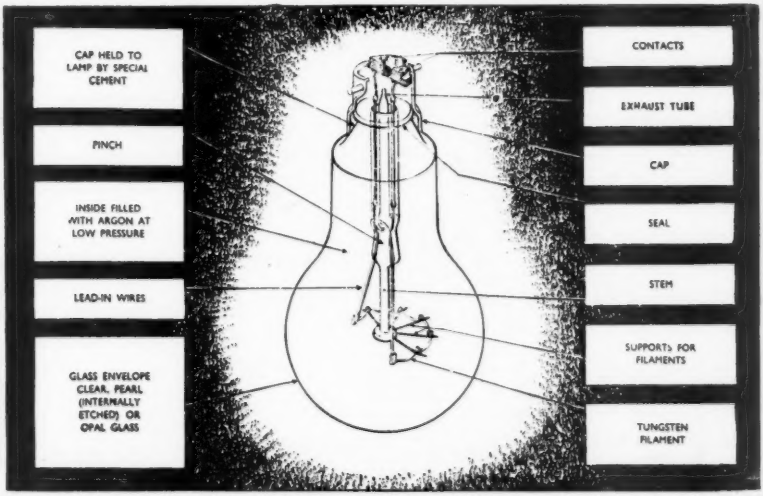
The lamp consists of a pear-shaped glass bulb fitted with a brass cap and contacts for connecting the mains. The filament wire is supported in the centre of the bulb. This filament is made of tungsten, the only metal capable of withstanding the high temperature necessary for the economic generation of light.

DEVELOPMENT

In the presence of air, even a tungsten filament will oxidise and fail at such a high temperature, so early lamps had a vacuum created inside the bulb to eliminate oxidisation. However, this caused a slow evaporation of the filament, blackening the bulb and shortening the life of the lamp. Later, more efficient lamps were produced by introducing into the bulb an inert gas, such as neon or argon, which does not oxidise the filament and retards evaporation. These are termed gas-filled lamps. The cooling effect of the gas was obviated by coiling the filament closely, so preventing free movement of the gas between the coils. In Coiled Coil lamps, this tight filament spiral is coiled a second time, bringing a further increase in efficiency.

TYPES

There are two main types for general service: Clear, having transparent bulbs suitable for use with reflectors and enclosed fittings; Pearl, in which the internal bulb surface is treated with acid to provide effective diffusion and reduce glare.



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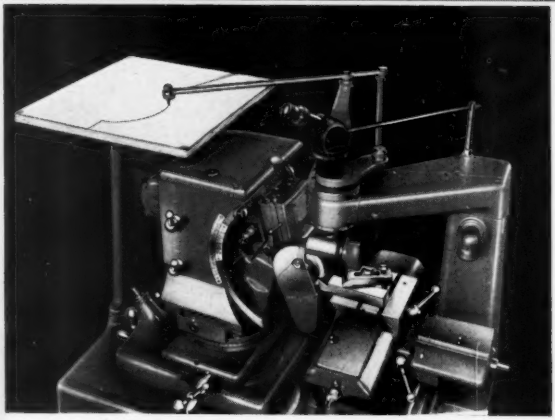

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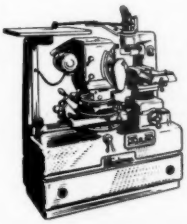
The machine will grind a form 5⅛" in length and 2½" in depth in parts 2" thick. The tool or workpiece, however, may be unlimited in length and up to 6¾" wide. *Catalogue on request.*



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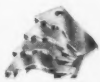
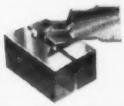


Profile Gauges, Templates, etc. The 2" stroke of the wheel permits a number of thin pieces to be ganged together.



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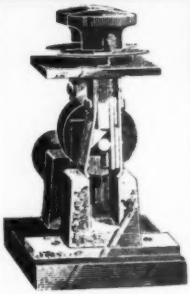

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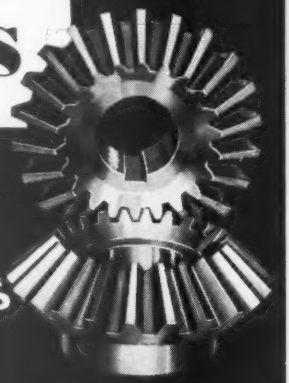

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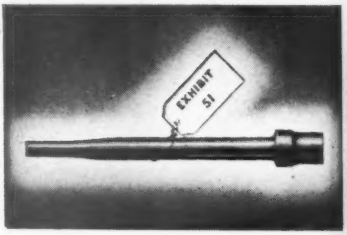

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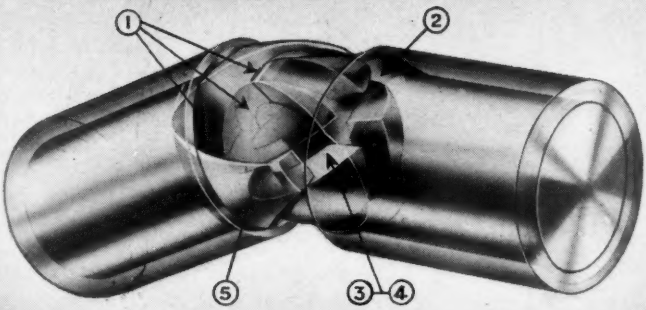

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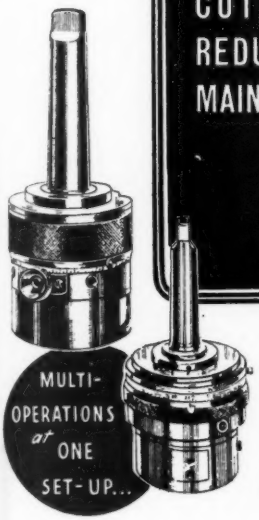

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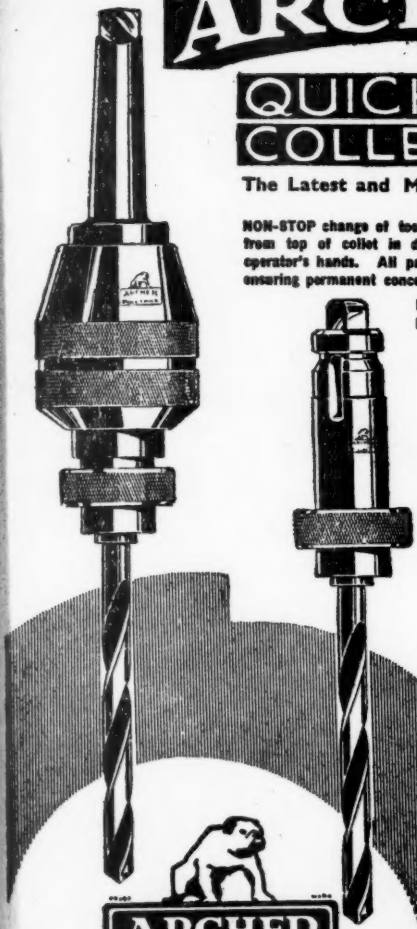

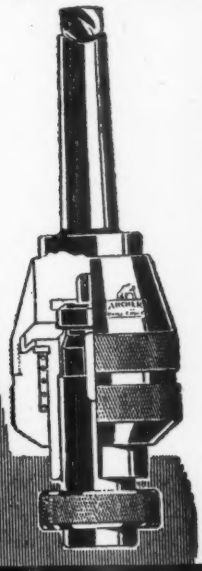

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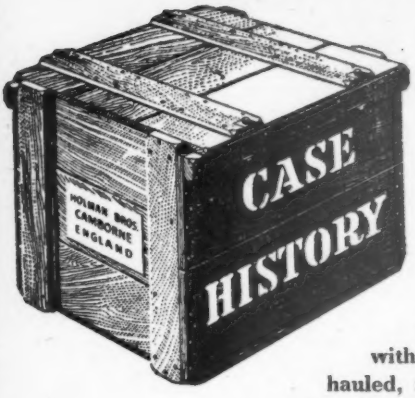

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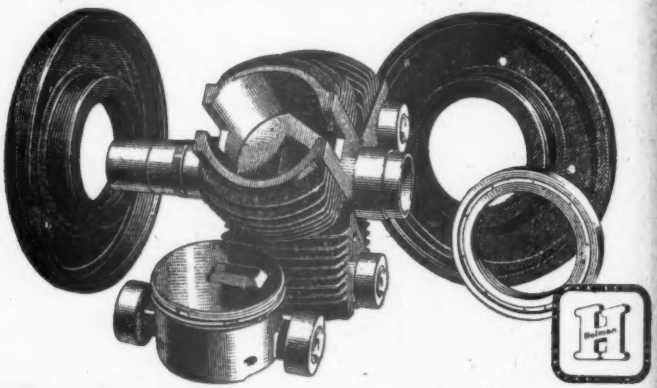

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